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Construction Site Accident Avoidance

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Abstract: ***Visual examination of the plant and in- time memorial to the failure of wearing a safety helmet is of particular significance to avoid injuries of workers at the construction point. Videotape monitoring systems give a large quantum of unshaped image data on- point for this purpose, still, taking a computer vision- based automatic result for real- time discovery. In this regard, we develop a deep learning-based system for the real- time discovery of a safety helmet at the construction point. i.e. presented system uses the YOLO algorithm that's grounded on convolutional neural networks. The trial results demonstrate that the presented machine learning-based model using the YOLO algorithm is able of detecting the unsafe operation of failure of wearing a helmet at the construction point, with satisfactory delicacy and efficiency. However, also the system generates a sound indicating it, If any worker fails to wear helmet.***

Using color code safety helmets at the workplace is very beneficial. It is also proved that many countries which are using color coding system for safety helmets, have made the working process fast and smooth. There are some specific standard color codes which are already defined for these safety helmets based on job sites or working environment you are present. It will be very helpful for identifying the key people at the time of emergency. This system ables to detect the particular job profile that the employees holding based upon the color of helmet he/she is wearing.

This system also includes a module which is able to detect whether the worker is working or idle. we analyze the movement of worker in real-time.

I. INTRODUCTION

Construction is a high- threat assiduity where construction workers tend to be hurt in the work process. Head injuries are veritably serious and frequently fatal. According to the accident statistics released by the state administration of work safety from 2015 to 2018, among the recorded 78 construction accidents, 53 events happed owing to the fact that the workers didn't wear safety helmets duly, counting for67.95 of the total number of accidents.

In safety operation at the construction point, it's essential to supervise the safety defensive outfit wearing condition of the construction workers. Safety helmets can bear and disperse the megahit of falling objects and palliate the damage of workers falling from heights. Construction workers tend to ignore safety helmets because of weak safety mindfulness. At the construction site, workers that wear safety helmets improperly are much more likely to be injured. In this project, we aim to automatically detect the uses of construction helmets whether the construction worker wears the helmet or not by analyzing the construction surveillance images taken from video.System automatically generates a sound if any worker fails to wear helmet.The human detection is an important in the construction site.This work is innovative, in that it combines the emerging computer vision and machine learning techniques to create a collaborative platform for construction safety performance measurement that helps to reduce construction worker fatalities and serious injuries caused by falls to a lower level. The prototype developed is a first-of-its-kind system that allows the stakeholders (e.g., contractors, architects, engineers, builders and owner representatives) to monitor and detect the uses of helmets on construction sites. In this project, firstly ,helmet is detected and its accuracy is shown for each helmet.

In computer vision, it is very hard to determine the high degree-of-freedom configuration of a human body with all its limbs, complex self-similar parts, self-occlusion, and large variations due to body-type, lighting, clothing and many other factors. Human pose estimation problems are computer vision techniques that predict the location of various human keypoints (landmarks and joints) such as neck, knees, elbows, shoulders, chest hips etc. So, here we use Mediapipe and Opencv libraries to detect the worker activity.The movement of hands plays the key role in deciding whether the worker is working or not. In this project, we also analyze the movement of worker in real-time.

Color detection is the process of detecting the name of the color. For humans, it is an easy task but for computers, it is not straight forward. So, here we use Pandas and OpenCV for detecting the particular job profile(i.e., labour, supervisor, site visitor, welder) that the employee is holding based upon the color of helmet he/she is wearing. This can be done by clicking on the helmet.

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II. LITERATURE REVIEW

At present, previous studies of safety helmets detection are often divided into three parts, sensor based detection, machine learning-based detection, and deep learning-based detection. Sensor based detection usually locates the security helmets and workers. The methods usually use the RFID tags and readers to locate the helmets and workers and monitor how personal protective equipment is worn by workers in real time.

Kelam designed a mobile frequency Identification portal for checking personal protective equipment (PPE) compliance of personnel. However, the working range of the RFID readers is proscribed and therefore the RFID readers can only suggest that the security helmets are near the workers but unable to substantiate that the security helmets are being properly worn. machine learning-based object detection technologies are widely employed in many domains for its powerful object detection and classification capacity.

Remarkable studies are made by Rubaiyat, who proposed an automatic detection method to get the features of construction workers and safety helmets and detect safety helmets. the strategy combines the frequency domain information of the image with the histogram of oriented gradient (HOG) and therefore the circle Hough transform extractive technique to detect the workers and also the helmets in two steps.

The detection methods supported machine learning can detect safety helmets accurately and precisely under various scenarios but even have some drawbacks. Sometimes the tactic can only detect safety helmets with a selected color and it's difficult to tell apart the hats with similar color and shape to the security helmets.

The above-mentioned methods are commonly supported traditional machine learning to detect and classify the helmets and choose features artificially with a powerful subjectivity, a posh design process, and poor generalization ability. In recent years, with the rapid development of deep learning technology, the item detection algorithm turns to the one supported convolutional neural networks with an excellent promotion of speed and accuracy.

The methods construct convolutional neural networks with different depths to detect safety helmets another strategies like multiscale training, increasing the quantity of anchors and introducing the net hard example mining, are added to extend the detection accuracy.

However, these methods have some limitations within the preprocessing aspects of image sharpness, object proportion, and also the color difference between background and foreground.

the matter of human (e.g., construction worker) detection is to automatically locate people in a picture or video sequence, which has been actively investigated within the past decade. Human detection has sort of applications like video-based surveillance, automatic tagging in visual content management, autonomous driving etc. the matter of human detection has many challenges related to it. The literature of helmet use detection is incredibly limited. it's considerably a replacement topic in computer vision and machine learning. Majority of the works focused on using color information for helmet detection. Du et al. described a combined machine learning and image processing approach for helmet detection in video sequences.

III. SYSTEM DESIGN

System design is that the second step within the system life cycle, during which overall design of the system is achieved. The functionalities of the system is meant and studied during this phase. the primary step is designing of program specification. This determines the varied data inputs to the system, data flow and also the format within which output is to be obtained.

A. Use Case Diagram

Use case diagram are wont to gather the necessities of a system including internal and external influences. These requirements are mostly design requirements.

So when a system is analyzed to assemble its functionalities use cases are prepared and actors are identified. In brief, the purposes of use case diagrams is as follows:

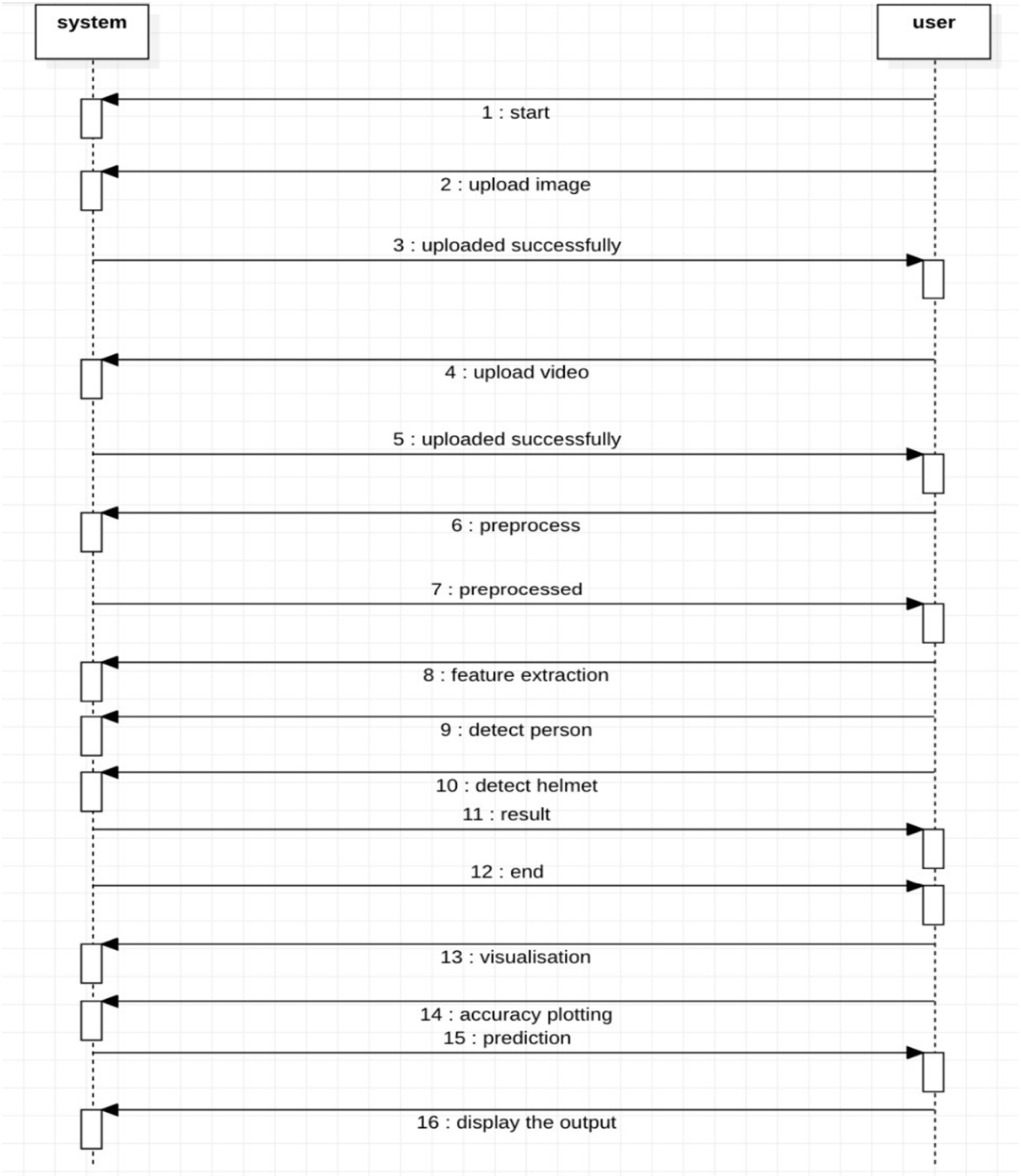
1) Used to gather requirements of a system
2) Used to get an outdoor view of a system
3) Identify external and internal factors influencing the system.

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start
upload image
upload video
pre-process
feature extraction
detect person
detect helmet
detect helmet from video
final result
user
system

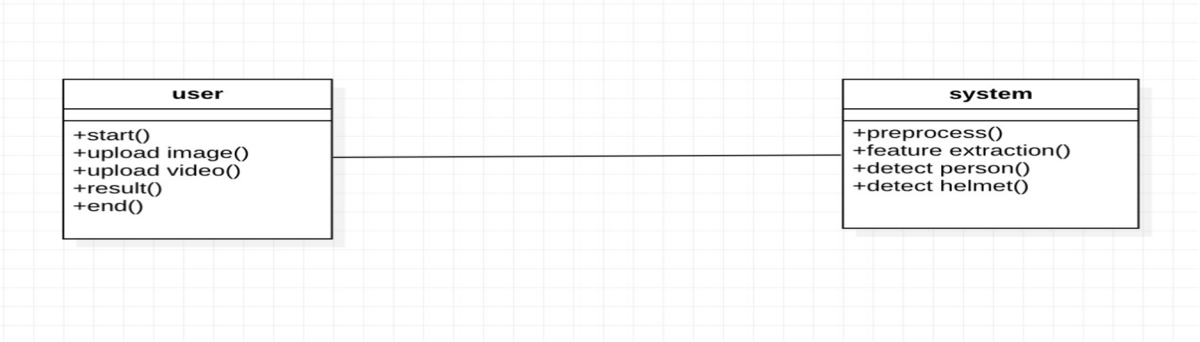
B. Sequence Diagram

Sequence Diagrams Represent the objects participating the interaction horizontally and time vertically. A Use Case may be a reasonably behavioral classifier that represents a declaration of an offered behavior. Each use case specifies some behavior, possibly including variants that the topic can perform unitedly with one or more actors. Use cases define the offered behavior of the topic without relevance its internal structure. These behaviors, involving interactions between the actor and also the subject, may lead to changes to the state of the topic and communications with its environment. A use case can include possible variations of its basic behavior, including exceptional behavior and error handling.



C. Class Diagram

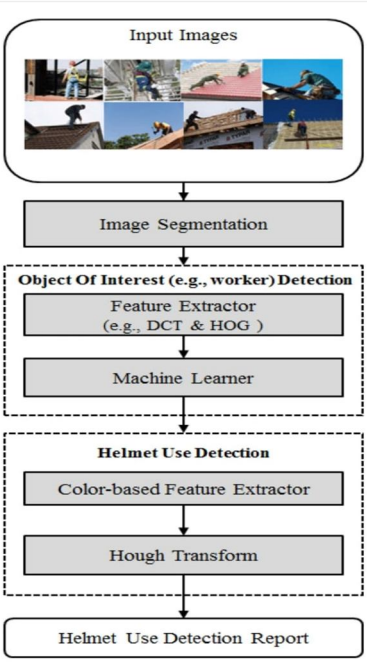
The class diagram is that the main building block of object-oriented modeling. it's used for general conceptual modeling of the systematic of the appliance, and for detailed modeling translating the models into programming code. Class diagrams may be used for data modeling. The classes in a very class diagram represent both the most elements, interactions within the application, and also the classes to be programmed.



IV. IMPLEMENTATION

The overall system architecture for helmet use detection for construction safety is performed based on the construction surveillance images, which consists of three major components: image segmentation, object of interest (i.e., construction worker) detector, and helmet use detector.

Image Segmentation: For the collected images, a semantic image segmentation algorithm, such as Gaussian Mixture Model (GMM), is first applied to partition each of the relevant construction surveillance images into a set of object regions (e.g., scaffold, roof, sky, worker, etc). Object of Interest Detector: After image segmentation, in order to recognize whether the segmented object regions are construction workers, Discrete Cosine Transform (DCT) is computed to extract the frequency domain information from the spatial domain image, and then Histogram of Oriented Gradient (HOG) features are drawn from the DCT coefficients. Resting on these features of the segmented regions, supervised classifier (i.e., Support Vector Machine (SVM) with linear kernel) is applied to detect whether there's construction worker in the image. (See Section IV-B for detail.) Helmet Use Detector: After detecting the object of interest (i.e., construction worker in our application), a combination of color-based and Circle Hough Transform (CHT) feature extraction techniques is applied for helmet use detection.



Implementation

In the other module which recognizes the worker activity,opencv and mediapipe plays a crucial role. One of the key parts of computer vision is the human body pose estimation. Estimating an workers entire body includes detecting joints and limbs and eliminating clothing, light and image noise.

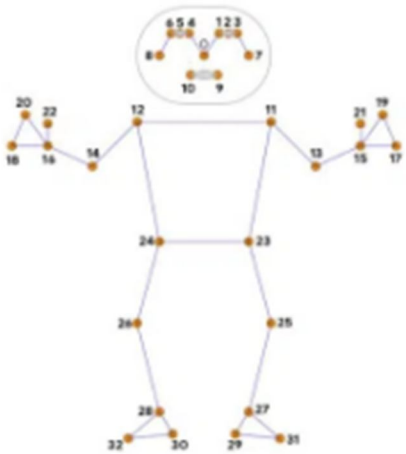
OpenCv has a wide range of services and tools to implement image processing extraction and manipulation. Mediapipe is a open-source framework that is mainly used for live-streaming media.It has ML solutions known as pipeline for cross-platform in many languages.

A. Video Capturing With Opencv

Opencv has a built-in solution to engage a streaming device, capture a video stream, and provide video frames. OpenCv Video Capture library is called for usage and this library can read frames of video and display them in a window. Once we have our video frames in RGB, to track the worker activity, we can use Mediapipe's Pose on video frames.

B. Estimating Activity Using Medipipe's Pose

Pose takes only 2 arguments known as detecting confidence and tracking confidence. These are nothing but strictness of preciseness we want in our resulting pipeline. Each frame updates the landmark coordinates. Each frame updates the landmark coordinates.



0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

33 full-body pose landmark

V. WORKING AND RESULT

A. User Interface



B. Detecting Persons

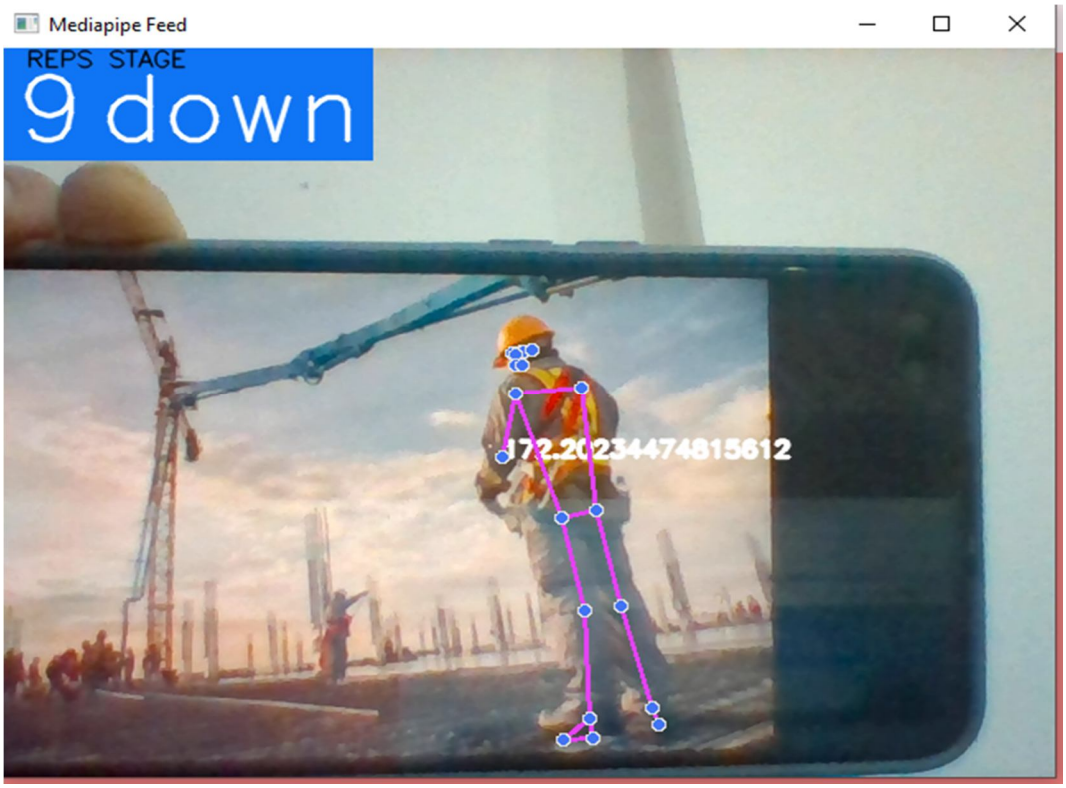


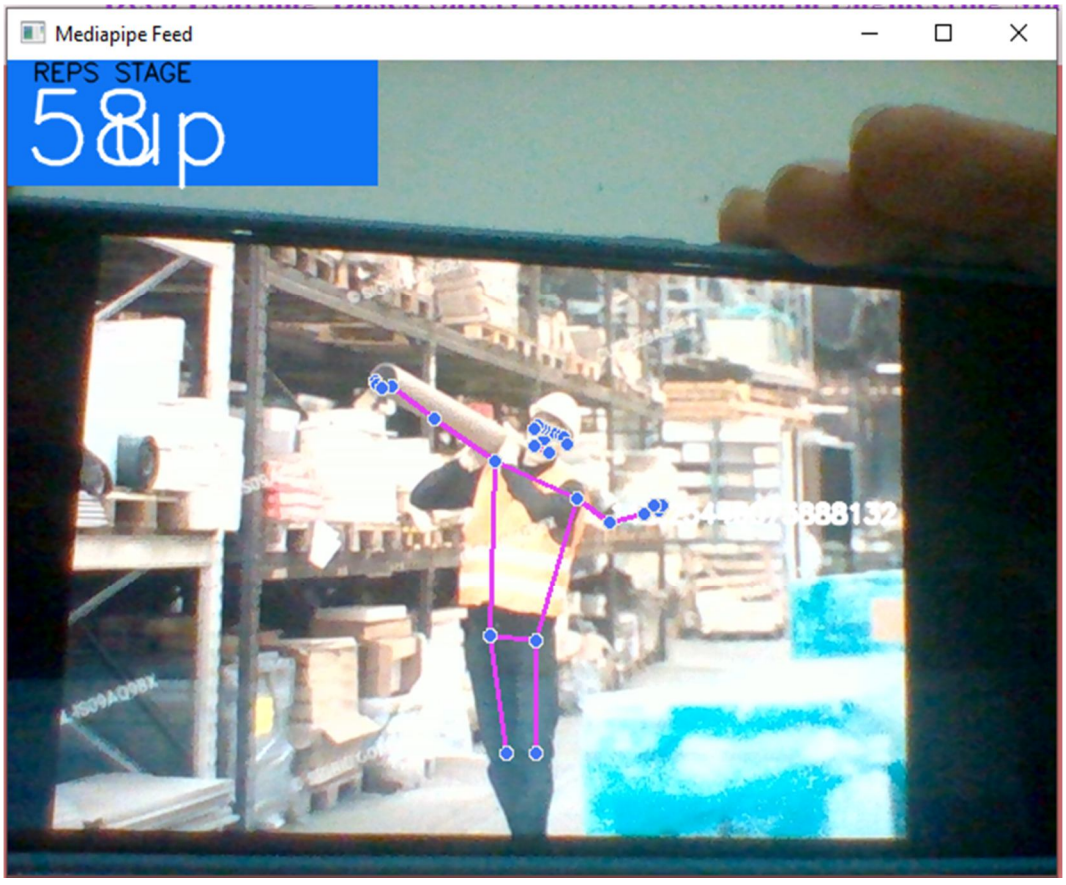
C. Detecting Safety Helmets



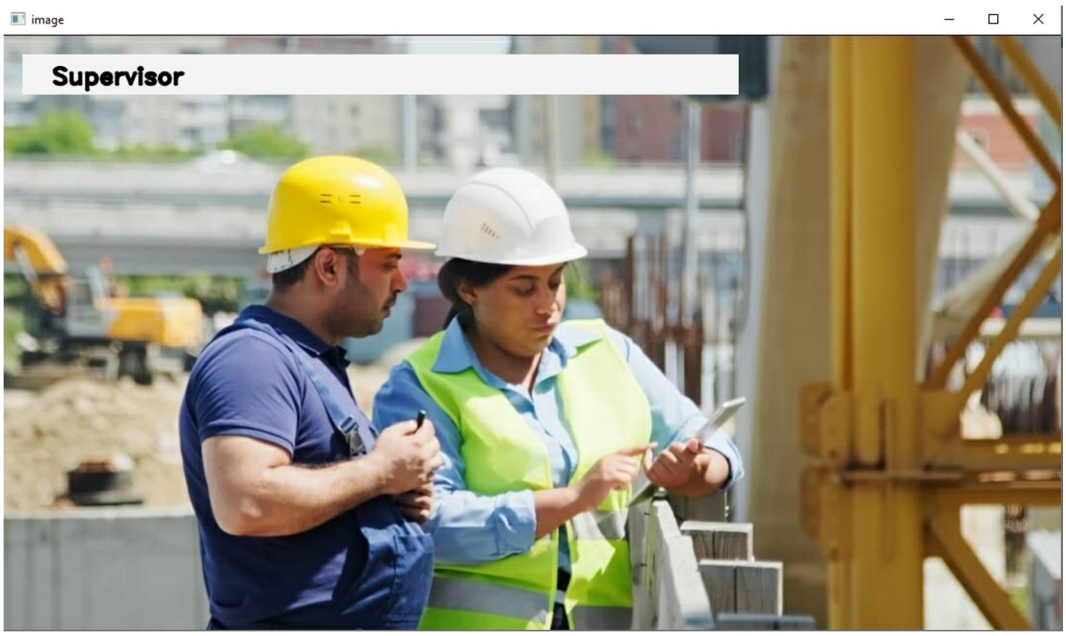


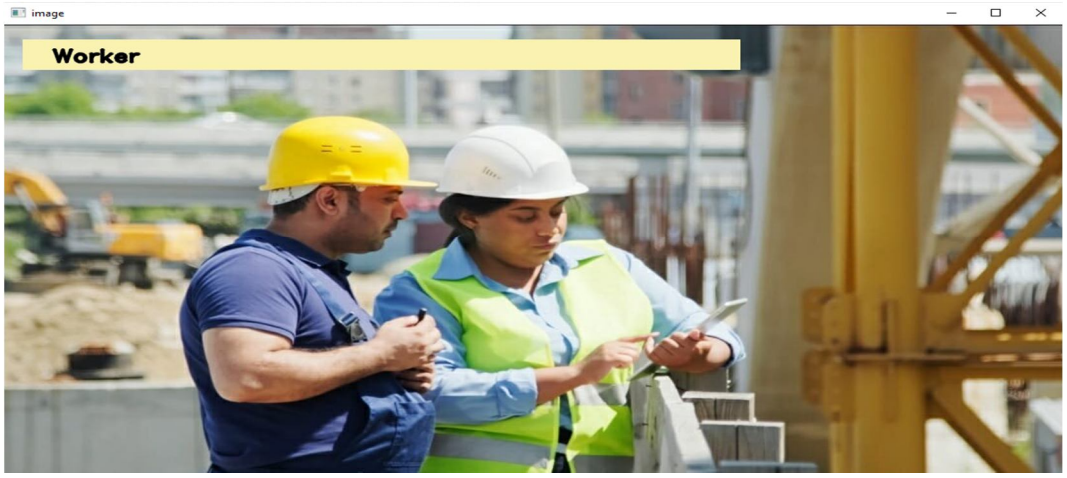
D. Detecting Worker Activity





E. Detecting Job Profile of Employee





VI. CONCLUSION

In this project, a completely unique approach is proposed for automatic detection of helmet uses for construction safety using computer vision and machine learning techniques. The proposed system has two major parts. Currently, our system can detect helmets composed of some particular colors, like yellow, blue, red, and white. As an extension of this work, we aim to create the system scalable to detect helmets with other colors. In future, the system are made well capable of differentiating between normal cap and helmet, because the proposed system shows low performance during this case. Also, we aim to use some deep learning techniques for improving the accuracy of the system. Also, applying upper body searching algorithm rather than detecting whole human as object of interest can improve the helmet detection accuracy.We also aim to search out the proper accuracy of wearing helmet and action of worker within the construction site.

.From the system we get know whether the worker is idle or working. this can be done by detection of worker hand movement taken from the video capturing in real-time.

From the system we are able to detect the actual job profile of employee based upon the helmet color.

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VII.FUTURE SCOPE

A Non-Helmet Worker Detection system is developed where a video file is taken as input. If the worker within the video-footage isn't wearing helmet while working within the construction site, and so here we are uploading image to spot the worker picture is extracted from image and displayed. Object detection principle with YOLO architecture is employed for person, helmet and detection. if worker isn't wearing helmet. Not only the characters are extracted, but also the frame from which it's also extracted in order that it will be used for other purposes. All the objectives of the project is achieved satisfactorily.

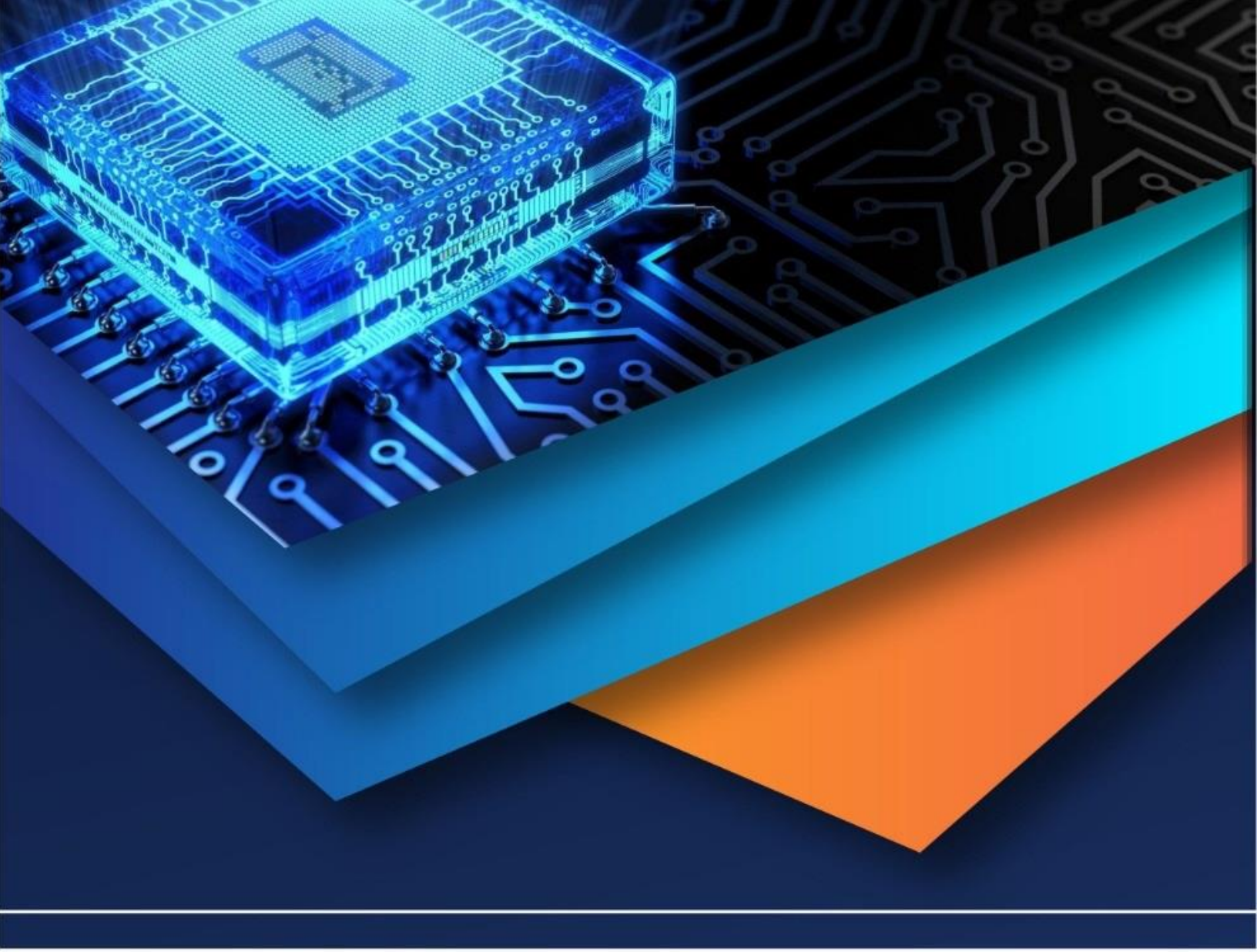
In the module ,Worker activity recognision, system can improved to detect other activities like walking, running, siting, standing etc..

In the Module, which detects the actual job profile supported the helmet color, image is given as input. Enhancement is made on the system to just accept the video input or to require real-time data.

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