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Martin BOHUŠÍK[1], Vladimír BULEJ[2], Ivan KURIC[3]

Opiekun naukowy: Ivan KURIC

ZASTOSOWANIA WIZJI KOMPUTEROWEJ W DZIEDZINIE BEZPIECZEŃSTWA

Streszczenie: Widzenie komputerowe jest obecnie wykorzystywane w wielu branżach. W artykule skupiono się na zastosowaniu sztucznej inteligencji (wizji komputerowej) do wykrywania cech bezpieczeństwa u pracownika. Do wykrywania, a następnie klasyfikacji cech bezpieczeństwa wykorzystano konwolucyjne sieci neuronowe. Dzięki wdrożeniu opisanych aplikacji w przemyśle można wyeliminować wiele możliwych urazów pracownika - zderzenie osoby z wózkiem widłowym, ochrona oczu przed odłamaniem ostrza szlifierką kątową itp.

Słowa kluczowe: sztuczna inteligencja, widzenie komputerowe, bezpieczeństwo

APPLICATIONS OF COMPUTER VISION IN THE SAFETY FIELD

Summary: Computer vision is currently used in a wide range of industries. This paper focuses on the application of artificial intelligence (computer vision) for detecting safety features on a worker. For the detection and subsequent classification of security features, convolutional neural networks were used. By implementing the described applications in industry, it is possible to eliminate many possible injuries to the worker - a crash of a person with a forklift, protection of the eyes from breaking off a blade with an angle grinder, etc.

Keywords: artificial intelligence, computer vision, safety

1. Introduction

The following study contains an overview of the use of computer vision in the industrial field, to eliminate potential risks in the context of worker safety.
Continuous monitoring of risky circumstances and action is crucial for construction safety and health in order to quickly eliminate possible dangers. Computer vision

[1] Ing., University in Žilina, Faculty of Mechanical Engineering, Department of Automation and Production Systems, e-mail: martin.bohusik@fstroj.uniza.sk
[2] Assoc.-prof., Ing., PhD., University in Žilina, Faculty of Mechanical Engineering, Department of Automation and Production Systems, e-mail: vladimir.bulej@fstroj.uniza.sk
[3] prof. Dr. Ing., University of Bielsko-Biała, Faculty of Mechanical Engineering and Computer Science, Department of Industrial Engineering: kuric.ivan@gmail.com

techniques have been used to extract safety-related information from site photos and videos as a reliable and automated method of field observation. These techniques are viewed as useful alternatives to the time-consuming and unreliable hand observational techniques currently used. Despite considerable research efforts being made in the area of computer vision-based safety and health monitoring, there are still many technical obstacles and research hurdles that need to be overcome before it can be used in real-world situations. This work provides an overview three categories - object detection, object tracking, and action recognition - based on the kinds of data needed to assess dangerous situations and behaviours. The findings show that significant research issues include thorough picture comprehension, variable tracking accuracy by camera position, and action recognition of several pieces of machinery and workers. [1]

2. Methodology

Personal Protective Equipment (PPE) is a piece of equipment for the prevention of illnesses and injuries at work. These illnesses and injuries are the result of a variety of workplace risks, such as radioactive, chemical, and electrical risks, among others. Figure 1 depicts numerous PPE types. Personal protective equipment consists of bodysuits that cover the entire body, gloves that protect the hands, safety glasses, work boots, helmets, safety vests, respirators, and ear protection. [2]

Figure 1. Types of PPE [2]

Figure 2 presents a structure for the Safety and Compliance Management System to ensure safer circumstances during construction. In accordance with the proposed framework, image sensing devices are first used to create an image data set that includes three different CV techniques: (I) Object detection approach; (II) Object tracking; and (III) Action recognition technique in accordance with the unsafe and complaint conditions. In order to employ the next approaches, object tracking and action recognition, object detection must first be used to identify conditions/situation-based dangers. Using object tracking techniques, location can be tracked, allowing for the monitoring of location-based dangerous and complaint acts. Sequential images are used to help action recognition techniques identify what construction-related entities (such as workers and equipment) are doing in order to check for unsafe behaviours that might violate safety and compliance protocols. [2]

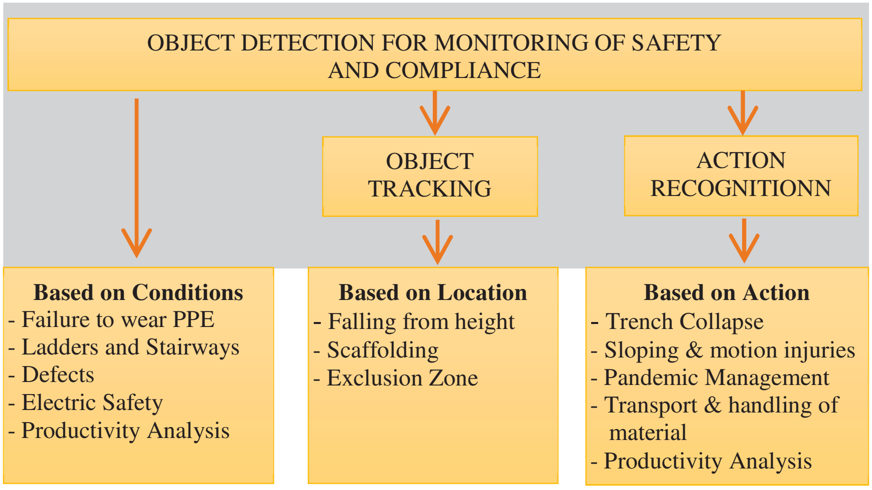

Figure 2. The Safety and Compliance Management System Framework [2]

One form of knowledge intensive work is construction safety management. When conducting a jobsite safety inspection, site managers and engineers must extract visual information using their perceptual ability. This information is then reasoned to identify potential hazards and corresponding mitigation measures based on existing safety rules in regulations and their experiences. This is shown in Figure 3.

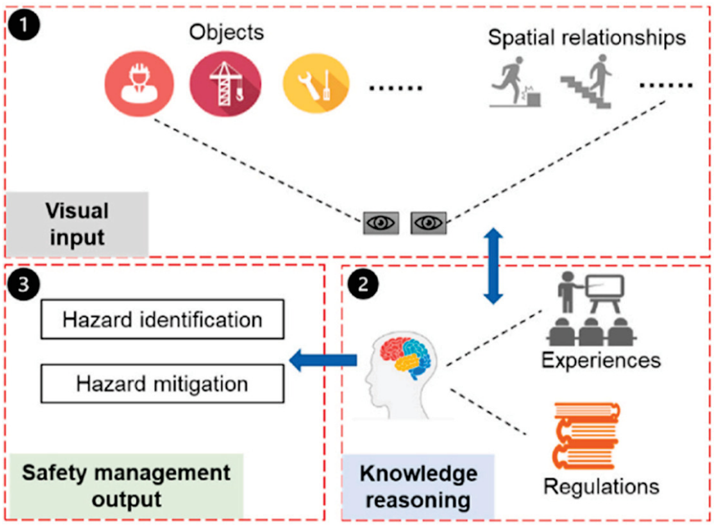

Figure 3. An example of the manual construction safety management process [3]

As with human visual systems, computer vision may automate visual tasks (detecting the two workers, concrete supports, ropes form...) [3]
The whole tracking method's flowchart is shown in Figure. 4. Video frames make up the input data, while each target's bounding box (a rectangle-shaped region) makes up the output data.

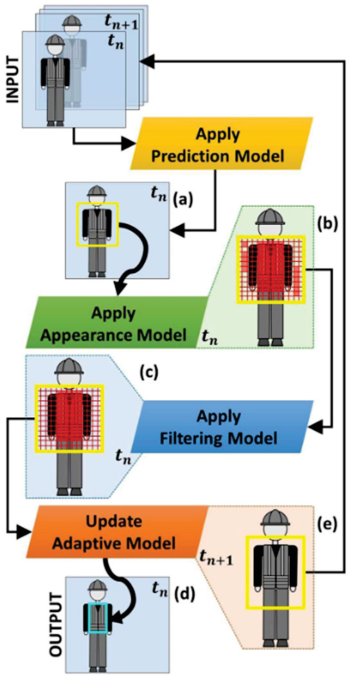

Figure 4. Diagram illustrating the suggested computer vision-based 2D tracking technique. [4]

Skewed parallelogram shapes in this diagram represent the sequential procedures used to track every target within a frame at time tn. These skewed parallelograms' shaded sections next to each other show the results of each process. The proposed filtering model is summarized in Figure 5.

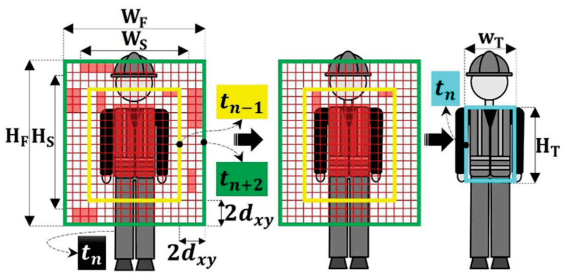

Figure 5. Suggested filtering technique. (a) Finding outliers within the RF of a filter. (b) Outliers are filtered. (c) Grouping the final RT region's positively classified patches. [4]

The outliers are first found. Second, the filtering model ignores them, and finally, RT is retrieved from the corrected tracked region. The performance of the appearance model is improved by the filtering model. This is due to the fact that the latter determines the region RT by fitting all positively classed patches with the constant $\{p_i\}_{i=1.N}$ into a bounding box N of a region RS. Figure. 6a depicts the segmentation and classification operations in (a) and (b), respectively. Workers' high visibility clothing typically differs in terms of: a) color combinations, such as orange and yellow; b) kind of clothing, such as a jacket, vest, or uniform; c) design pattern of reflective grey stripes; and d) faded colors, such as those that are soiled or worn out. The body of each target is segmented to lessen the impact of these variances in appearance. The hyperplane f(x) is shown in Figure 6b, where it splits two segmentations - pi (+1) is the segmentation for the pixels of the security features on the worker, and pi (-1) is the segmentation for the background pixels. [4]

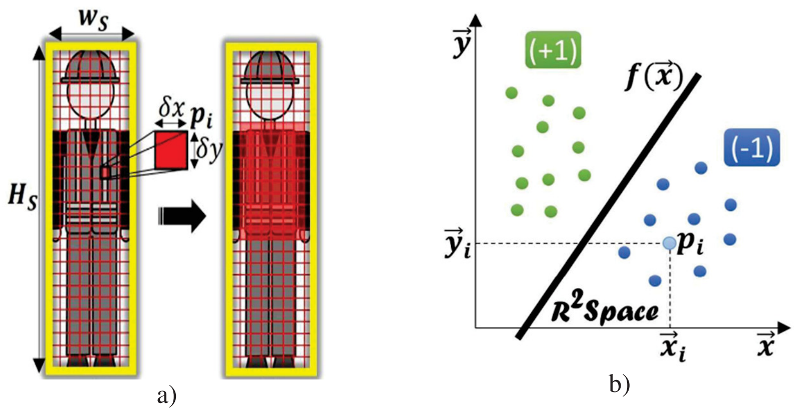

Figure 6. a) Segmentation of the region RS into rectangular patches $\{pi\}_{i=1}$. . N. and Classification of the segmented patches $\{pi\}_{i=1}$. . N as part of tracked worker's Hi-Vis apparel. b) Linear classification of colour image patches with an SVM. [4]

3. Computer vision applications in safety

Even while occupational health and safety has improved over time, many industrial accidents still occur in the Europe each year. Accidents that cause harm or, in extreme situations, even death happen frequently. Computer vision can prevent the majority of these accidents. The development of computer vision in safety is therefore inevitable.

3.1. Forklift Safety, Forklift Accident Prediction, and Forklift Accident Prevention.

For manufacturing facilities, warehouses, yards, depots, and other similar locations, forklift and pedestrian-related dangers are listed as one of the main issues. Computer vision monitors forklift movement in the designated area. Accidents and occurrences involving speeding, moving in the wrong direction, parking in a traffic lane, pedestrians who do not use the sidewalk, and other violations that may cause accidents are reported. Monitoring of persons in the vicinity of the forklift is shown in Figure 7. [5]

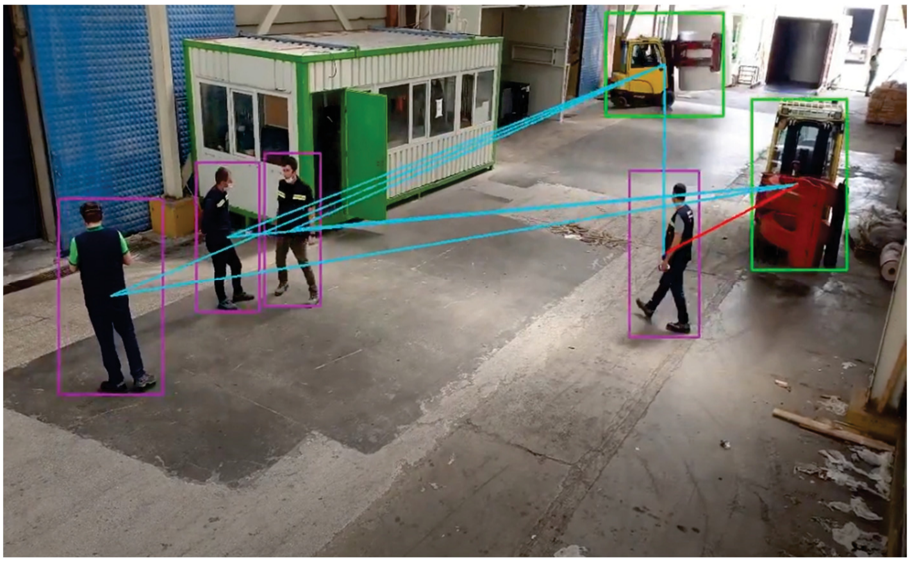

Figure 7. Forklift MHE Safety [5]

3.2. Utilization of Lifting Devices

Computer vison can recognise various sorts of loads inside a building and can identify the lifting equipment utilized in a particular area. It can keep an eye on the tasks the lifting apparatus is utilized for. It can give personnel walking or standing under suspended loads real-time warnings. Monitoring of persons in the vicinity of the lifting devices is shown in Figure 8.

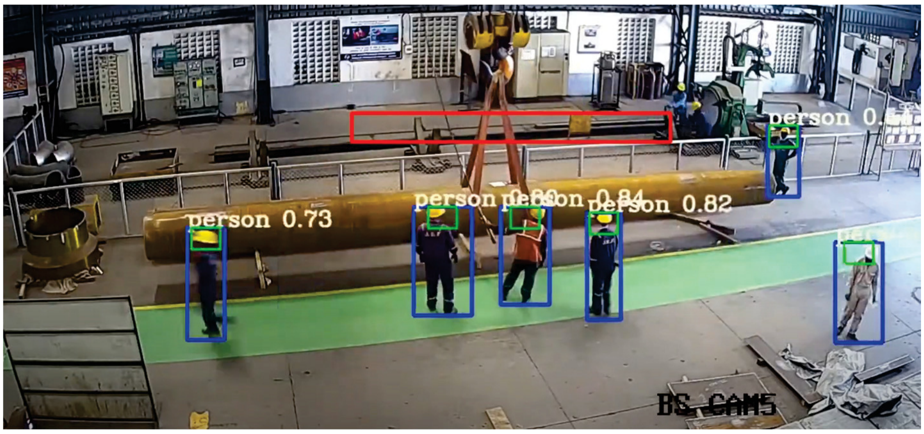

Figure 8. Utilization of Lifting Devices [5]

3.3. Work at Height

The load on a raised platform is monitored by a computer vision system. It recognizes PPE and ensures proper equipment usage. detects falling objects and overcrowding on scaffolding. The use of the appropriate equipment, monitoring the load on an elevated platform, identifying falling objects, and entry into the exclusion zone are also monitored. Monitoring of persons in the vicinity of the work at height is shown in Figure 9.

Figure 9. Work at Height [5]

3.4. Machine Guarding

A computer vision system can identify workers who are in a dangerous area and instantly notify them. In the event that an employee is found close to a machine, warnings may also be given to the operators. Additionally, it can keep track of routine machine maintenance and lubrication, preventing breakdowns and accidents. Additionally, the technology might send out instantaneous alerts in the event of accidents, which would speed up the delivery of first aid. Monitoring of persons in the vicinity of the machine guarding is shown in Figure 10.

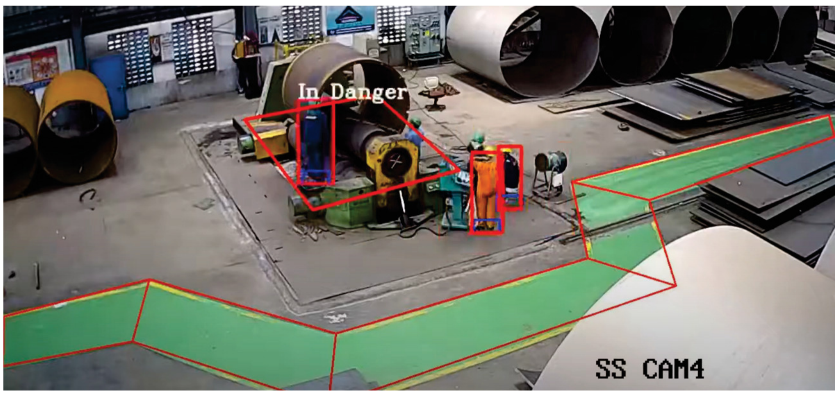

Figure 10. Machine Guarding [5]

4. Conclusion

The article describes the methodology and applications of artificial intelligence (machine vision) in the field of security. Due to the importance of safety and everyday risks, it is necessary to constantly pay more attention to the safety of employees. Our next research will consist in creating our own neural network and then training it on similar examples as the ones presented in this article, e.g. detecting safety features on a worker. YOLO will be used as the object detection algorithms.

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