**Research Assessment #2**

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**Subject:** Hardhat detection for construction safety

**MLA/APA citation:**

Mneymneh, Bahaa Eddine, et al. “Automated Hardhat Detection for Construction Safety Applications.” Procedia Engineering, vol. 196, 2017, pp. 895–902., https://doi.org/10.1016/j.proeng.2017.08.022.

**Assessment:**

Construction sites are one of the most dangerous industries, and it is only getting worse as time passes by, according to injury and fatality statistics by the U.S. Bureau of Labor Statistics. While a lot of accidents are caused by inevitable and unfortunate circumstances, a lot of others are easily preventable with basic safety precautions. This includes the proper use of personal protective equipment (PPE), which is unfortunately not always followed. Therefore, in construction sites, the use of PPE is often monitored by safety officers. However, in large areas with a large number of workers, this becomes harder to achieve. The use of automated hardhat detection will allow for cost-effective, quick, and accurate evaluation of proper PPE use of workers and lower risks of injuries or fatalities.

The use of information technology and computer-based tools in the construction field has been looked at multiple times. More specifically, there has been other research regarding object detection to increase construction safety. However, there have been many limitations. The algorithms that have been created for construction safety required high-resolution CCTV cameras. The actual assessment was not done on the site. There were also lots of over-prediction and false identification, especially under more challenging scenarios, such as variations of orientation, color, background contrast, image resolution, and on-site lighting conditions. Last but not least, these assessments were not timely enough to be practically applied to construction safety.

This paper focuses on different methods of computer vision techniques in detecting hardhats. One of the methods is feature detection, extraction, and matching. This method is beneficial to detect non-repeating texture patterns to allow unique and numerous feature matches. This method is found to be ineffective in detecting hardhat due to the lack of details in hardhats. While this could be overcome by applying stickers on hardhats, it made the algorithm susceptible to misclassifying other objects with stickers as hardhat. Another limitation of this method is due to the three-dimensional space shown only in two-dimension when imaged, which can have angles that do not contain a clear view of the sticker.

Another method is template matching, which is when a series of operations aim to detect and identify a certain pattern by comparing it to a reference. Generally, this method is considered accurate. However, this method is limited by available computational power due to lengthy iteration processes. When testing this method, it was found that a unified template is not sufficient to detect all instances and is inaccurate when dealing with different scales and rotations.

Lastly, the authors looked into the cascade classifier method based on the Histogram of Oriented Gradients (HOG), Haar-like, and Local Binary Pattern (LBP) features. While the authors found Haar and LBP highly inaccurate, the HOG feature was found to accurately detect the circular shape of the hardhat regardless of its color. It was also found that HOG was able to identify hardhats regardless of viewpoints from 3 sets of testing images of different viewpoints.

In the future, findings in this paper could be further developed through the improvement of the accuracy of the hardhat detection process and elimination of false detection by combining cascade classifier with image and color segmentation. The potential use of heat cameras could be looked into as well. Lastly, the integration of this technology in construction sites will be greatly beneficial to the workers.