DSR-YOLOv8:
A Dangerous Behavior Detection Algorithm for Electric Power Construction Workers Based on Depthwise Separable Residual Improved YOLOv8

Lingwen Meng
http://orcid.org/0009-0008-9563-6170
Electric Power Research Institute of Guizhou Power Grid Co. Ltd., China

Shasha Luo
Electric Power Research Institute of Guizhou Power Grid Co. Ltd., China

Jiangang Liu
Electric Power Research Institute of Guizhou Power Grid Co. Ltd., China

Bangming Zhang
Electric Power Research Institute of Guizhou Power Grid Co. Ltd., China

Zhonghai Ruan
GuangZhou Power Electrical Technology Co., Ltd., China
Received: April 24th, 2025 | **Accepted:** November 5th, 2025

ABSTRACT

The power construction industry's growth demands efficient monitoring of high-risk worker behaviors, yet traditional methods are inefficient and existing models face false alarms in complex scenes. This study proposes DSR-YOLOv8, an improved YOLOv8 algorithm integrating three modules: (1) DSRAB using deep separable convolution and global pooling to enhance subtle action features and denoising; (2) SD_SPPF with multi-scale dilated kernels to expand the receptive field while reducing computational costs; (3) dynamic region-processing with partial convolutional heads to focus on critical areas and suppress interference. Evaluated on a self-built Dangerous Behavior Dataset (DBD) containing "helmet-wearing," "no helmet," and "smoking" scenarios, DSR-YOLOv8 achieved 91.2% accuracy (+3.5%) and 89.7% mAP (+3.6%) over baselines, demonstrating efficient hazardous behavior detection for enhanced safety in power construction.

KEYWORDS

Electric Power Construction, Dangerous Behavior Detection, Depthwise Separable Residuals, YOLOv8

INTRODUCTION

In recent years, the power construction industry has become increasingly important as a driving force for social progress and economic development (Belagiannis & Zisserman, 2017; Insafutdinov et al., 2016). However, the high-risk characteristics of power construction, such as high-altitude operations, and electrical operations., make the work behavior of construction personnel directly related to the smooth progress of the project and the safety of personnel. With the continuous increase in power engineering projects, safety issues during the construction process have become increasingly

DOI: 10.4018/IJACI.404000

prominent, becoming a bottleneck restricting the development of the power construction industry (Bulat & Tzimiropoulos, 2016; Hollnagel & Goteman, 2004; Mohammadfam et al., 2017). In power construction, the dangerous behaviors of construction personnel, include not wearing safety helmets according to regulations and smoking in hazardous areas, are a serious concern. The construction site has a complex environment and many personnel. Wearing safety helmets according to regulations can effectively ensure the personal safety of workers. When a high-altitude object falls, a safety helmet helps protect the worker's head from being struck by such hard objects, saving lives in critical moments. In addition, smoking at construction sites is also an unsafe behavior. At construction sites, building materials of all sizes are usually stacked together, and some of these materials are flammable. Once a fire is triggered, the consequences can be very serious. Therefore, it is particularly important to detect smoking behavior in a timely manner and stop it immediately.

Conventional monitoring paradigms predominantly depend on manual oversight, a approach fraught with limitations including high operational costs, susceptibility to human error, and inadequate scalability. In hazardous situations, traditional methods mainly focus on computer vision and image processing techniques as well as traditional feature engineering methods (Swain & Guttmann, 1983; Wang et al., 2022). For example, the MIT Multimedia Laboratory has developed the Pfinder automatic monitoring system (Wren et al., 1997), which can track and locate workers in surveillance videos. However, the system records the behavior trajectory of workers and does not determine the type of worker behavior. Rubaiyat et al. (2016) proposed an automatic helmet detection method, that first combines the frequency domain information of the image with directional gradient histograms (HOGs) and then applies a combination of color and circular Hough transform (CHT) feature extraction techniques.

To address this challenge, computer vision and deep learning have opened up new possibilities. Significant advances have been made in object detection in recent years, largely driven by deep learning models. Mainstream deep learning-based detection algorithms are primarily divided into two types: the two-stage method, such as the R-CNN series (Redmon & Farhadi, 2017), and the single-stage approach, represented by the YOLO series (Bochkovskiy et al., 2020; Redmon & Farhadi, 2018; Wang et al., 2023), both of which are widely used in dangerous behavior detection. Numerous studies have optimized these frameworks. For instance, Mask R-CNN (Bharati & Pramanik, 2020) significantly improved accuracy by integrating a segmentation branch, while Cascade R-CNN (Cai & Vasconcelos, 2019) excelled in high-quality detection through multi-stage regression and classification. However, two-stage methods generally lag in detection efficiency compared with single-stage models, driving current research to focus on enhancing the accuracy of the latter. The YOLOv1 algorithm, introduced in 2015, unified candidate box extraction and detection into a single stage, directly regressing object location and category to greatly increase speed. The YOLOv2 (YOLO9000) incorporated Anchor Box and used K-means clustering to better estimate prior boxes, further boosting performance. Also in 2016, the SSD algorithm (Liu et al., 2016) leveraged multi-scale feature maps for improved detection across varying object sizes. YOLOv3 (Redmon & Farhadi, 2018) introduced residual connections with Darknet-53 as its backbone and adopted a feature pyramid (FPN) Lin, T,117) approach for predictions at three scales, enhancing both accuracy and speed. The YOLOv4 (Gai et al., 2023) optimized multiple aspects including data processing, backbone architecture, and loss function without major structural changes. That same year, YOLOv5 (Jocher et al., 2020) employed a Focus and CSP backbone, along with an FPN+PAN neck, and incorporated training tricks to improve speed and precision. The YOLO series continues to evolve with later iterations such as YOLOX and YOLOv7 (Wang et al., 2023). Most recently, YOLOv8 was introduced by the Ultralytics team, building upon YOLOv7 with a new backbone, Anchor-Free detection head, and updated loss function, further advancing object detection performance.

In the field of dangerous behavior detection, many researchers domestically and abroad widely applied single-stage object detection methods for efficient and timely identification of hazardous actions. For instance, Tong et al. (2019) introduced an Inception-v3 network to detect whether

Related Content

Software Engineering Strategies for Real-Time Personalization in E-Commerce Recommendations
Kirti Jain, Atishay Jain, Aditya Bharadwajand Ram Vashisth (2024). *Advancing Software Engineering Through AI, Federated Learning, and Large Language Models (pp. 40-53).*
www.irma-international.org/chapter/software-engineering-strategies-for-real-time-personalization-in-e-commerce-recommendations/346322

The Role of AI in Zero Trust Architectures
Tushar, Nandita Pradhan, Venktesh Mishra, Ajay Sharma, Pooja Jaiswal, Ajit Kumar Yadav, Shyam Sundar, Satya Prakash Singh, Shatrughan Mishra, Manish Kumar, Sweta Singh, Shivani Mishra, Chitranjan Dwivediand Bhupesh Chandra Kushwaha (2027). *Generative AI for Cyber Risk Management (pp. 149-180).*
www.irma-international.org/chapter/the-role-of-ai-in-zero-trust-architectures/413290

Building Data Warehouses Using Automation
Nayem Rahmanand Dale Rutz (2015). *International Journal of Intelligent Information Technologies (pp. 1-22).*
www.irma-international.org/article/building-data-warehouses-using-automation/135903

Reskilling and Upskilling Future Educators for the Demands of Artificial Intelligence in the Modern Era of Education
Karthik Raja Srinivasan, Nur Hairani Abd Rahmanand Sri Devi Ravana (2025). *Pitfalls of AI Integration in Education: Skill Obsolescence, Misuse, and Bias (pp. 171-196).*
www.irma-international.org/chapter/reskilling-and-upskilling-future-educators-for-the-demands-of-artificial-intelligence-in-the-modern-era-of-education/379665

ISCG: An Intelligent Sensing and Caption Generation System for Object Detection and Captioning Using Deep Learning
Aahan Singh, Nithin Nagaraj, Srinidhi Hiriyannaiahand Lalit Mohan Patnaik (2020). *International Journal of Intelligent Information Technologies (pp. 51-67).*
www.irma-international.org/article/iscg/262979