Indonesia University of Education

Automated Violation Detection Model in Streaming Mine Areas to Improve Occupational Health and Safety (OHS)

Rahmat Syarif Azhari (zack@upi.edu), Lala Septem Riza (lala.s.riza@upi.edu), Rani Megasari (megasari@upi.edu), Bimantoro Aulia Rizky (bimantoroar@upi.edu), Cahyaningtyas Rindhu Murdowati (cahyaningtyas@beraucoalenergy.co.id)

sbcc 2024

International Symposium and Workshop on Sustainable Buildings, Cities, and Communities "Building Low Carbon Future: Decarbonizing with Impact"

Introduction : Mine Accident Videos

sbcc 2024

Automated Violation Detection Model in Streaming Mine Areas to Improve Occupational Health and Safety (OHS) | Rahmat Syarif Azhari
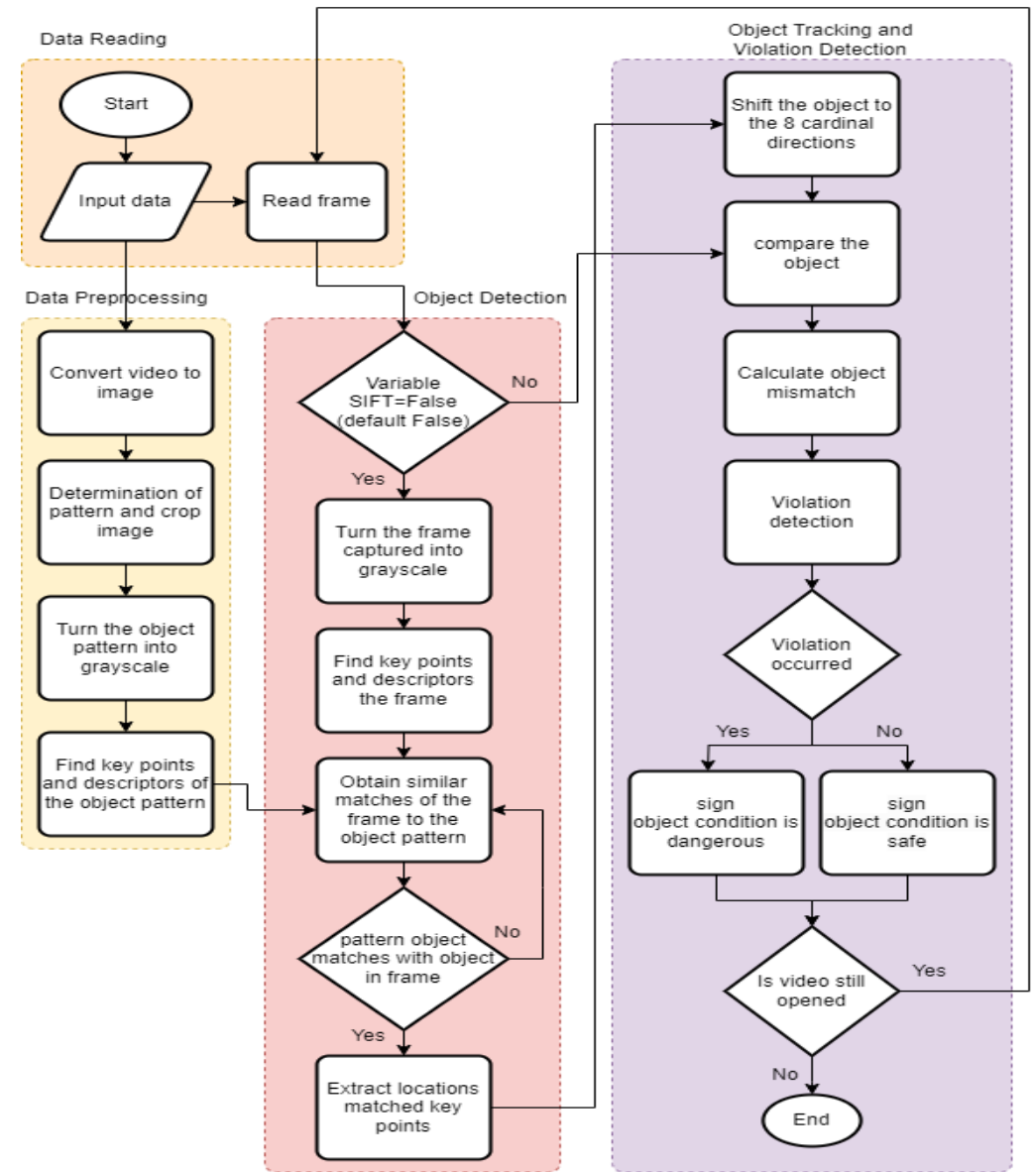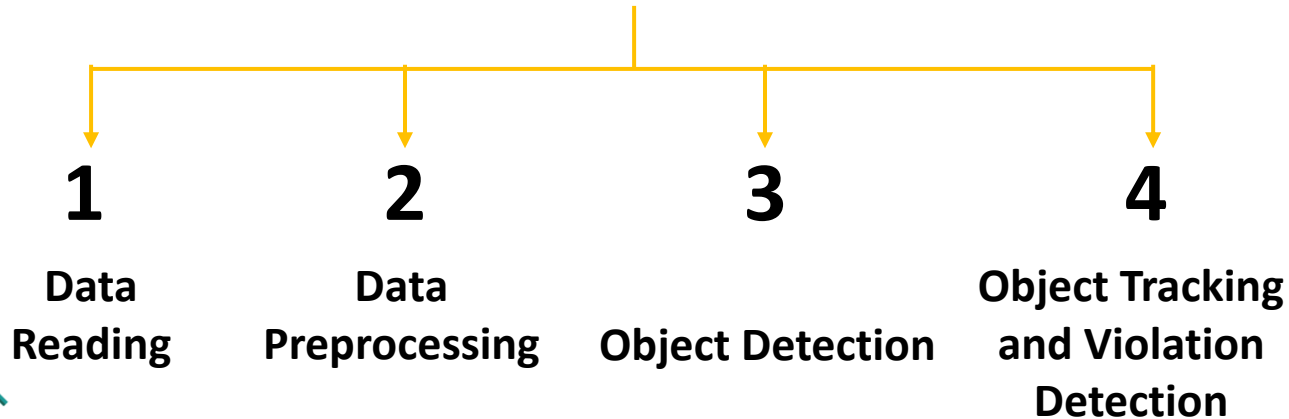
Introduction and Literature Review

- Industrial development around the world makes occupational health and safety aspects a matter that must be considered [1] and the mining sector is the most dangerous sector compared to other sectors [2]. Supervision is necessary to secure any mining activity [3] however, field supervisors can also potentially put themselves in danger.

- Some researchers have developed surveillance using technologies, but most studies lack specificity in addressing the problem [4,5,6,7,8].

- Therefore, in this study, we propose a new model for detecting violations using image processing techniques [9] and can already handle specific problems.

Material and Methods

The material used are 5 post event videos data obtained from CCTV streaming video records.
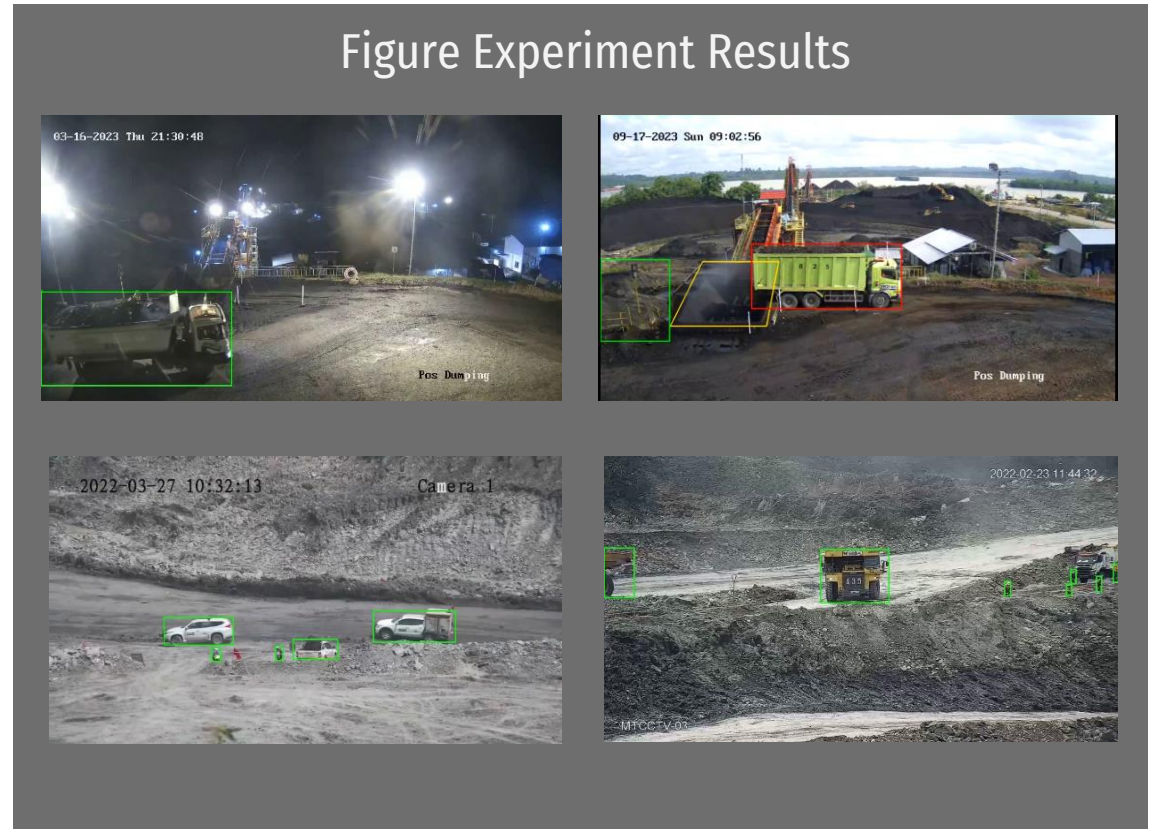
Computational Model

1

Data Reading

2

Data Preprocessing

3

Object Detection

4

Object Tracking and Violation Detection

Data Reading

Start

Input data → Read frame

Data Preprocessing

Convert video to image

Determination of pattern and crop image

Turn the object pattern into grayscale

Find key points and descriptors of the object pattern

Object Detection

Variable SIFT=False (default False) — No / Yes

Turn the frame captured into grayscale

Find key points and descriptors the frame

Obtain similar matches of the frame to the object pattern

pattern object matches with object in frame — No / Yes

Extract locations matched key points

Object Tracking and Violation Detection

Shift the object to the 8 cardinal directions

compare the object

Calculate object mismatch

Violation detection

Violation occurred — Yes / No

sign object condition is dangerous

sign object condition is safe

Is video still opened — Yes / No

End

sbcc 2024

Result and Discussion

Table Experiment
Result Confusion Matrix

Video	Accuracy	Precision	Recall
Sampel 1	68.57%	89%	75%
Sampel 2	87.50%	93.33%	93%
Sampel 3	43.59%	80.95%	49%
Sampel 4	33.33%	50%	50%
Sampel 5	72.72%	88.89%	80%
Total	**61.14%**	**80.41%**	**69.38%**

Figure Experiment Results

Video Result

Conclusion

- The computational model can be run in streaming to detect violations thereby improving occupational health and safety (OHS).

- Our model proposes four steps to detect violations, namely (i) data reading, (ii) data pre-processing, (iii) object detection, and (iv) object tracking and violation detection.

- The cumulative program accuracy is 61.14% with 80.41% precision and 69.38% recall.

- The model computation time for one frame averaged 0.6 seconds using the SIFT algorithm and 0.3 seconds using the heuristic.

sbcc 2024

Automated Violation Detection Model in Streaming Mine Areas to Improve Occupational Health and Safety (OHS) | Rahmat Syarif Azhari

References

[1] Amalina, N. N., & Larasati, H. E. (2020). The Implementation of Contractor Safety Management System to Prevent Work Accidents at Coal Mining Company. Indonesian Journal of Occupational Safety and Health, 9(3), 338–348. https://doi.org/10.20473/ijosh.v9i3.2020.338-348.

[2] Hermanus, M. A. (2007). Occupational health and safety in mining-status, new developments, and concerns. Journal of the Southern African Institute of Mining and Metallurgy, 107(8), 531-538.

[3] Puluhulawa, F. U. (2011). Supervision as an Instrument of Law Enforcement in the management of Mineral and Coal Mining Business. Journal of Legal Dynamics, 11(2), 306-315.

[4] Xu, Z., Li, J., & Zhang, M. (2021). A surveillance video real-time analysis system based on edge-cloud and fl-yolo cooperation in coal mine. IEEE Access, 9, 68482-68497.

[5] Seo, J., Han, S., Lee, S., & Kim, H. (2015). Computer vision techniques for construction safety and health monitoring. Advanced Engineering Informatics, 29(2), 239-251.

[6] Gao, Y., Lin, Q., Xu, C., & Li, W. (2022, June). Intelligent video surveillance of sand mining based on object detection and tracking. In Journal of Physics: Conference Series (Vol. 2277, No. 1, p. 012002). IOP Publishing.

[7] Son, H., Seong, H., Choi, H., & Kim, C. (2019). Real-time vision-based warning system for prevention of collisions between workers and heavy equipment. Journal of Computing in Civil Engineering, 33(5), 04019029.

[8] Imam, M., Baïna, K., Tabii, Y., Ressami, E. M., Adlaoui, Y., Benzakour, I., & Abdelwahed, E. H. (2023). The future of mine safety: a comprehensive review of anti-collision systems based on computer vision in underground mines. Sensors, 23(9), 4294.

[9] Wiley, V., & Lucas, T. (2018). Computer vision and image processing: a paper review. International Journal of Artificial Intelligence Research, 2(1), 29-36