Development of Vision-based Insider Sabotage Detection System for Nuclear Security

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Abstract

Fukushima Daiichi nuclear power plant accident raised a fear that terrorists could cause a similar accident by acts of sabotage against nuclear facilities and especially sabotage by insider is worthy of attention. In addition, it appears that a significant portion of sabotage behaviors can be detected through hand motion monitoring.

In this study, a vision-based Deep Neural Network (DNN) model is proposed for hand motion recognition and sabotage detection in response to the certain limitations of Physical Protection System (PPS) in nuclear facilities.

Keywords: Nuclear security, Physical protection system, Insider sabotage, Deep neural network

1. Introduction

An urgent lesson learned from Fukushima Daiichi nuclear power plant accident is what can happen by natural disaster also can be made to happen by insider sabotage. In addition, a significant portion of sabotage behaviors such as modification to safety circuit board using tools and virus contamination on control computer using USB can be detected through hand motion monitoring. However, current countermeasures of insider sabotage are still with certain limitations. Thus, enhancement of existing PPS in nuclear facilities with a robust, applicable and high-performance real-time intelligent detection system via hand motion monitoring is necessary.

Long-term objective of this study is to develop a real-time insider sabotage detection system. To achieve this goal, a vision-based DNN model for hand motion recognition is proposed in this paper.

2. DNN Model

To address the bottleneck of DNN training data, we synthesize training images using a virtual 3D hand model [1]. At present, a hand state dataset of 17,760 images (consists of 10 hand states) with random background has already been generated for model validation purpose.

Given the remarkable performance of Convolutional Neural Network (CNN) in computer vision and pattern recognition, we train a CNN model based on the architecture of the famous AlexNet [2] to recognize 10 hand states in the dataset. Finally, our model achieves 80.47% accuracy in the experiment.

3. Conclusion

We present a vision-based DNN model for hand motion recognition and perform experiment on our synthesizing hand state dataset. Experimental results demonstrate the effectiveness of our proposed model in hand motion recognition.

References

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