

Real-time Safety Helmet Wearing Detection Based Using Face Features

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Abstract -Safety helmet wearing detection is very essential while traveling. We proposed a innovative and practical safety helmet wearing detection method based on image processing and machine learning. At first, the extract background modeling algorithm is exploited to detect motion object under a view of fix surveillant camera in power substation. After obtaining the motion region of interest, the Histogram of Oriented Gradient (HOG) feature is extracted to describe inner human. And then, based on the result of HOG feature extraction, the Support Vector Machine (SVM) is trained to classify pedestrians. Finally, the safety helmet detection will be implemented by color feature recognition. To ensure the safe operation of power equipments, more and more intelligent surveillance systems had been developed based on computer vision or image processing.

Key Words: vibe; histogram of oriented gradient; support vector machine; color feature recognition.

1. INTRODUCTION

Over the past decades, increasing accidents in power substation has raised many attention for safety monitor. In order to ensure the safe operation of power equipments, more and more intelligent surveillance systems had been developed based on computer vision or image processing [1]-[7]. This measure can not only address the problem of labour monitor, but also highlight the unsafe operation to avoid unexpected accidents. Safety helmet wearing detection is a very common and crucial task for surveillance in power substation. Whereas there are few researches for studying this problem by using image processing techniques. Most researches focus on the approach investigating of motorcyclists whether wearing or not safety helmets. Waranusast et al. developed an automatically detect system for motorcycle riders and was able to ascertain whether they are wearing helmets or not. This system extracts the motion objects and trains a K-Nearest-Neighbor (KNN) classifier for detection [8]. Silva et al. exploited the Hough circular transformation to determine the shape of safety helmet and use the extracted Histogram of Oriented Gradients (HOG) features to train a Multi-layer perceptron classifier, which can effectively and simply detect wearing helmet of motorcyclists [9]. In [10], the Kalman filtering and Cam-shift algorithm are used to track pedestrians and determine motion objects. Meanwhile, the color information of safety helmets is used to detect safety helmets wearing.

The objective of this paper is to present a novel and practical safety helmet wearing detection method based

on image processing and machine learning in power substation. In order to reduce detection range of surveillance video, the ViBe background modelling algorithm is adopted to segment motion objects in foreground frame. After that, we extract Histogram of Oriented Gradient (HOG) feature of pedestrians in corresponding range and use Support Vector Machine (SVM) to classify the human, Silva et al. exploited the Hough circular transformation to determine the shape of safety helmet and use the extracted Histogram of Oriented Gradients (HOG) features to train a Multi-layer perceptron classifier, which can effectively and simply detect wearing helmet of motorcyclists. In power substation, the surveillance camera is installed on the fixed location. So the view of camera is fixed which can make sure that the background can not change in frames. Consider this characteristic, we choose the ViBe background modeling algorithm. Moreover, this method is fast and effective to determine the motion objects. In order to detect the people in power substation whether wearing or not safety helmet, the second step is that obtaining the human location and image information. Thus, we extract the HOG feature of people and train the SVM classifier for people to classify pedestrian in power substation. When we know the human information in frames, we can utilize the color feature to detect safety helmet wearing situations.

2. LITERATURE SURVEY

Over the past decades, increasing accidents in power substation has raised many attention for safety monitor. In order to ensure the safe operation of power equipments, more and more intelligent surveillance systems had been developed based on computer vision or image processing [1]-[7]. This measure can not only address the problem of labour monitor, but also highlight the unsafe operation to avoid unexpected accidents. Safety helmet wearing detection is a very common and crucial task for surveillance in power substation. Whereas there are few researches for studying this problem by using image processing techniques. Most researches focus on the approach investigating of motorcyclists whether wearing or not safety helmets. Waranusast et al. developed an automatically detect system for motorcycle riders and was able to ascertain whether they are wearing helmets or not. This system extracts the motion objects and trains a K-Nearest-Neighbor (KNN) classifier for detection [8]. Silva et al. exploited the Hough circular transformation to determine the shape of safety helmet and use the extracted Histogram of Oriented Gradients (HOG) features to train a Multi-layer perceptron classifier, which can effectively and simply detect wearing helmet of motorcyclists [9]. In [10], the Kalman filtering and Cam-

shift algorithm are used to track pedestrians and determine motion objects. Meanwhile, the color information of safety helmets is used to detect safety helmets wearing.

[1] Paper: Computer vision applications in power substations.

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Power substations have an important role in the security and quality of supplies in a distribution system and it is necessary to pay particular attention to maintain a good system performance and to prevent the damage of equipment [1]–[3]. Furthermore, engineers in charge of the transmission network need to know not only the real-time status of power equipment but also the security and fire safety of the substation. In order to tackle fire safety and security requirements, the idea of remote vision for substation monitoring has been employed. Engineers and relevant staff are able to see on their remote display monitors the real-time scene of the indoor environment of the substation at different office locations or at home when they are standing by. Eight off-the-shelf CCTV cameras were installed at different locations of a power substation and the video signal from each camera was wired back to a “remote control and multiplexing box”. Through this box, the lighting contactors of the eight locations can be controlled to ensure adequate illumination level. Such box is controlled by the on-site PC via the printer port and the video signal of anyone camera can be selected to an image grabber card on a time-multiplexing basis. Communication between the PC and the maintenance centre can be accomplished by Intranet or by a modem in the case of very old substations.

[2] Paper: Towards automatic power line detection for a UAV surveillance system using pulse coupled neural filter and an improved Hough transform.

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Spatial information captured from optical remote sensors on board unmanned aerial vehicles (UAVs) has great potential in automatic surveillance of electrical infrastructure. For an automatic vision-based power line inspection system, detecting power lines from a cluttered background is one of the most important and challenging tasks. In this paper, a novel method is proposed, specifically for power line detection from aerial images. A pulse coupled neural filter is developed to remove background noise and generate an edge map prior to the Hough transform being employed to detect straight lines. An improved Hough transform is used by performing knowledge-based line clustering in Hough space to refine the detection results. The experiment on real image data captured from a UAV platform demonstrates that the proposed approach is effective for automatic power line detection.

[3] Paper: intelligent detection of electrical equipment faults in the overhead substations based machine vision

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With regard to the development of the power industry and its importance and key role it plays in the development of our country, the problems of this technology should be profoundly investigated. The recent concern for increasing efficiency has made the experts in the field take measures to decrease the fault rate. Considering the wide distribution and spread of distribution networks that makes it difficult to access them, this issue is of much more significance

3. PROPOSED SYSTEM

Safety helmet wearing detection is a very common and crucial task for surveillance in power substation. Whereas there are few researches for studying this problem by using image processing techniques. Most researches focus on the approach investigating of motorcyclists whether wearing or not safety helmets. Waranusast et al. developed an automatically detect system for motorcycle riders and was able to ascertain whether they are wearing helmets or not. This system extracts the motion objects and trains a K-Nearest-Neighbor (KNN) classifier for detection [8]. Silva et al. exploited the Hough circular transformation to determine the shape of safety helmet and use the extracted Histogram of Oriented Gradients (HOG) features to train a Multi-layer perceptron classifier, which can effectively and simply detect wearing helmet of motorcyclists. In power substation, the surveillance camera is installed on the fixed location. So the view of camera is fixed which can make sure that the background can not change in frames. Consider this characteristic, we choose the ViBe background modelling algorithm. Moreover, this method is fast and effective to determine the motion objects. In order to detect the people in power substation whether wearing or not safety helmet, the second step is that obtaining the human location and image information. Thus, we extract the HOG feature of people and train the SVM classifier for people to classify pedestrian in power substation. When we know the human information in frames, we can utilize the color feature to detect safety helmet wearing situations.

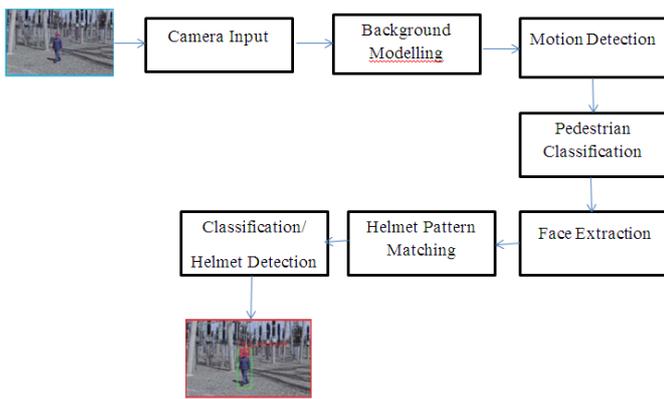


Fig.1. Block Diagram

Algorithm Vibe Algorithm

(1) Firstly, perform moving object detection for the current frame based on improved VIBE method to extract the background $IB(p,t)$ and foreground information $IF(p,t)$;

(2) For any pixel p in the current frame, if p is foreground pixel, then add it to PF , PF is the set of foreground pixel; if p is background pixel, then add it to PB , PB is the set of background pixel;

(3) Then obtain the clusters of foreground and background $\{RF_i\} (i = 1, 2, \dots, m)$ and $\{RB_j\} (j = 1, 2, \dots, n)$ respectively using meanshift clustering on the pixel of PF and PB ;

(4) Initialize the S/T Network model with corresponding image pixels as nodes (except S/T node);

(5) Calculate $Tlink$ and $Nlink$ to build likelihood energy function and construct Graph Cut model;

(6) Use max flow/minimum cut to segmentation S/T network to get binary label of each node.

(7) If one node is labeled S , then its corresponding image pixel is foreground; otherwise is background, then get the current foreground object mask.

Segmentation Algorithm:

1. Smooth the image with a Gaussian filter to reduce noise and unwanted details and textures.
2. Compute gradient of $g(m,n)$ using any of the gradient operators.
3. Threshold M : where T is so chosen that all edge elements are kept while most of the noise is suppressed.
4. Suppress non-maxima pixels in the edges in M_T obtained above to thin the edge ridges (as the edges might have been broadened in step 1).

5. Threshold the previous result by two different thresholds T_1 and T_2 (where $T_1 < T_2$) to obtain two binary images.
6. Link edge segments in T_2 to form continuous edges.

4. RESULTS

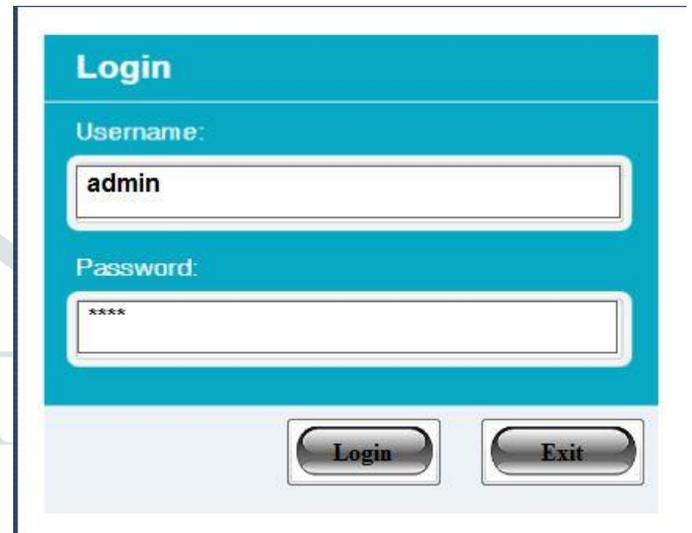


Fig. 2 Login Form



Fig. 3 Background Separation



Fig 4. Filter Image

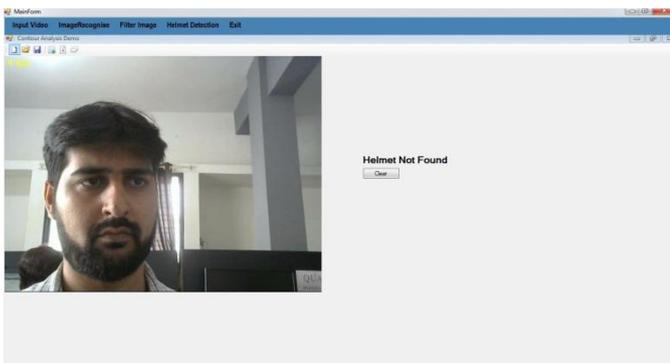


Fig 5. Helmet Detection

5. CONCLUSIONS

We have investigated a practical and novel method of safety helmets wearing detection in power substation which can real-time monitor the people whether wearing safety helmet or not. The image processing and machine learning techniques are employed in surveillance system of power substation. Firstly, ViBe background modelling algorithm was used to segment the moving objects under the view of monitoring camera. This trick could filter a lot of static objects. Moreover, the histogram of oriented gradient (HOG) feature extraction and support vector machine (SVM) classifier training were implemented to achieve human location per frame. Finally, we utilized color feature to recognize the safety helmet wearing situations. The overall method are verified by amount of experiments on the surveillance video of power substation.

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