ATLANTIS PRESS

Advances in Intelligent Systems Research, volume 147

International Conference on Network, Communication, Computer Engineering (NCCE 2018)

Detection of Glue Spray on Bottom of Vehicle Based on Machine Vision

Dongyang Liu [1], Jindong Zhang [1.2, 3, a)], Xiaofeng Zhang [3], Xiaoyu Ma [1], Yuxin Kou [1]

[1]*College of Computer Science and Technology, Jilin University, Changchun, 130012, China*
[2]*Key Laboratory of Symbol Computation and Knowledge Engineering of the Ministry of Education, Jilin University, Changchun,130012, China*
[3]*College of Software, Jilin University, Changchun, 130012, China*

[a)] Corresponding author: Zhang Jindong, E-mail: zhangjindong_100@163. com

Abstract. With the continuous development of machine vision, intelligent detection of bottom spray glue has gradually become a reality. In this paper, we proposed an algorithm of detection the glue spray on bottom of vehicle based on machine vision. By sampling and detecting the spray interest area, the algorithm can obtain its features which were used for intelligent identification of the spray interest area, and then carry out the pseudo target and detect whether the detection area is complete or not. It can test the vehicles on pipeline in real time. On the average, each frame's processing time is less than 150ms. If there is an unqualified area, it will alarm and inform the operators of the wrong position. The algorithm can improve the quality of the vehicle and save human resources and identify the spray interest area with high accuracy. The research directions in the future is to accelerate the speed to meet the practical application requirements, and to solve the intelligent identification of the spray interest area which has the same color with the vehicle body.

Key words: Glue spray, Machine vision, intelligent detection.

ALGORITHM DESCRIPTION

The algorithm can detect glue spray on bottom of vehicle through the pipeline in the real-time. And the method is to obtain the images of vehicle's bottom through the pipeline using the camera, and intelligently extract the spray area. The extracted area is region of interest. Then, all operations are performed in this region. The next step is the edge detection. If the spray area is complete, it will only detect the outer contour of the spray area. If there is a defect, in the process of detection, besides the outer contour, the defect part will also have its own small contour. In this situation, we can conclude that the spray interest area is not qualified, record the location and return to the operators, to accelerate the repair of the region. The flow chart of the detection algorithm of vehicle bottom's glue spray as shown in Figure 1.

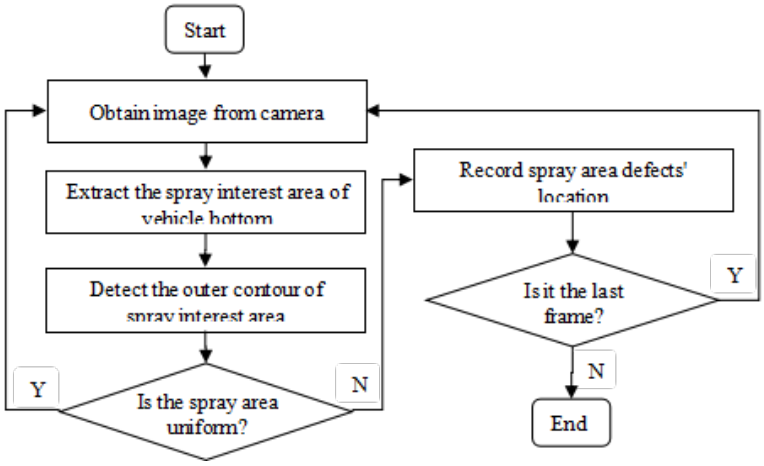

FIGURE 1. The flow chart

Main Modules Design

Intelligent detection of glue spray area includes color transformation, edge detection, using rectangle to surround the largest area, detection of the uniform of the area is divided into edge detection, pseudo target removal, return the unqualified area. The main modules of the algorithm is shown in Figure 2.

How to exactly find the spray zone is an important problem, which is directly related to the success of the whole algorithm. As the spray zone is a whole white area, each frame of the image has this distinct feature. The data structure of each pixel includes R(red), G (green), B (blue) these three primary colors, all the rest of the color is composed of these three colors, each color's range is 0~255, (0, 0, 0) is black, (255, 255, 255) is white, and so on. Each color has its own value, referred to as the RGB value. The algorithm obtains the entire image in this way by default, called the RGB color space. So, we would like to traverse the entire image, read each pixel. If it is white, go to the next pixel, otherwise directly transformed to (0, 0, 0).

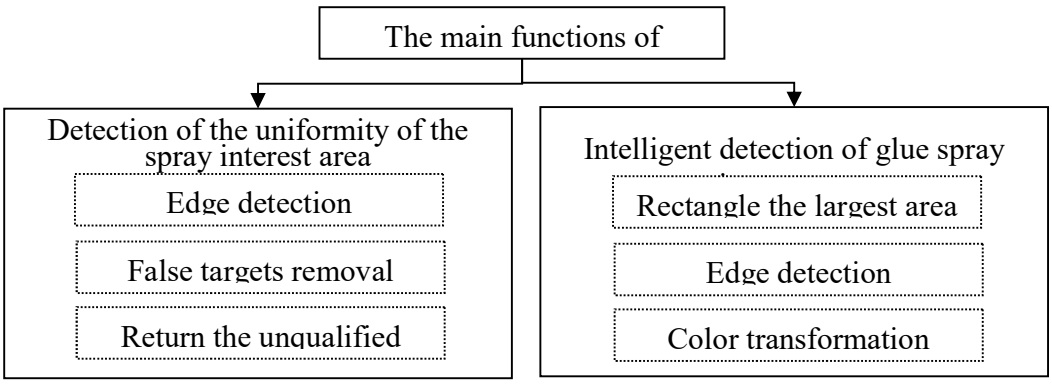

FIGURE 2. The modules of the algorithm

Ideally, the processing of each frame image will only have a spray area of white, so we can accurately extract the spray interest area. However, after some tests, it was found that some of the spray interest area was painted black, and some other areas were remain. The reason is that RGB color space is sensitive to interference, such as light, distance from the camera. So, we discard the RGB color space, replaced by a more anti-jamming color space called HSV color space (H (hue), S (saturation), V (value)). This space has its advantages, but there are still some shortcoming in contrast of RGB color space, such as black in the color space is still (0, 0, 0). But for white, there is no accurate value. Because each of H, S, V can produce white. So we extract the HSV value of the spray interest area, and find the approximate area. The graphs are shown in Figure 3, the RGB graph is shown in Figure 4.

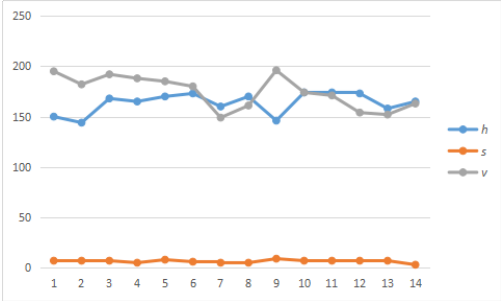

FIGURE 3. The value of HSV color space

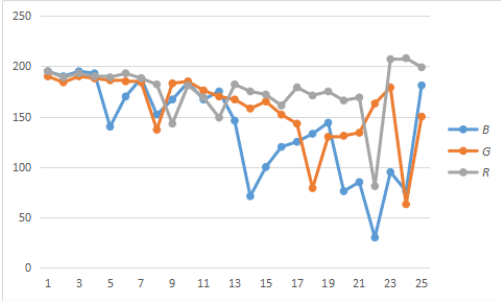

FIGURE 4. The value of RGB color space

In Figure 3&4, we can find that the HSV color space is more stable than RGB color space, especially in the second half of each frame. So we decided to choose the HSV color space. Every frame has the only black and white color, and filtering it, average value filter is based on the size type kernel size as template filtering. The specific operation is that every pixel's value is the average values of the pixels around the area, size of area is the nuclear size. The next step is to do contour edge detection on the image, and draw a rectangle out of the largest contour, the spray interest area. The pseudo code as follow:

```
IF successfully obtain a frame
THEN RGB color space→HSV color space.
FOR (i= first pixel, i<=last pixel, step+1)
IF color ≠white
THEN color=black.
END IF. END FOR.
//average value filter.
//contour edge detection.
//discrete point approximation the largest contour.
//Draw a rectangle out of it.
//Cut this rectangle to set as interest spray area.
END IF.
```

RESULTS AND ANALYSIS

The laptop running the algorithm is configured as follow: CPU-Intel(R) Core(TM) i7-6700HQ CPU @ 2.60GHz, graphics card-NVIDIA GeForce GTX 960M, memory-8GB, hard disk-1TB. In the previous chapter, we said the reason of why not choose RGB. In the Figure 5, 6 and 7, we will show the other benefit of HSV color space (the different value of HSV between spray interest area and vehicle body). The actual processing process in the pipeline is shown in Figure 9.

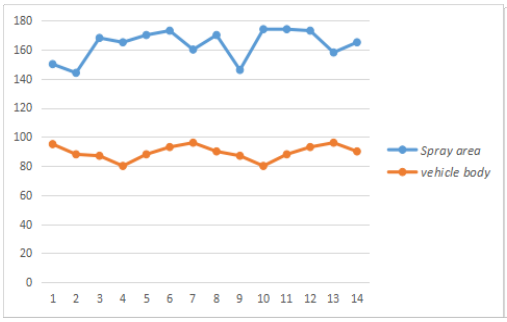

FIGURE 5. The different value of H

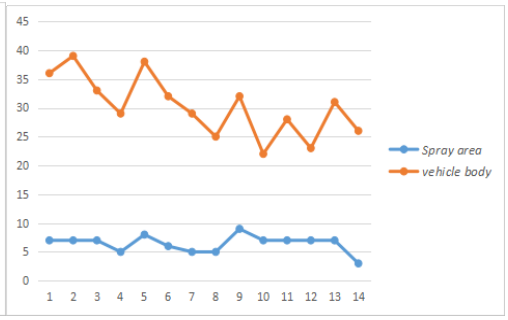

FIGURE 6. The different value of S

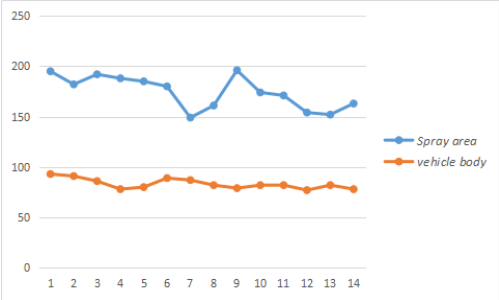

FIGURE 7. The different value of V

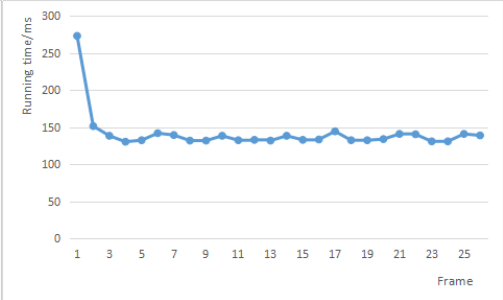

FIGURE 8. Each frame's processing time

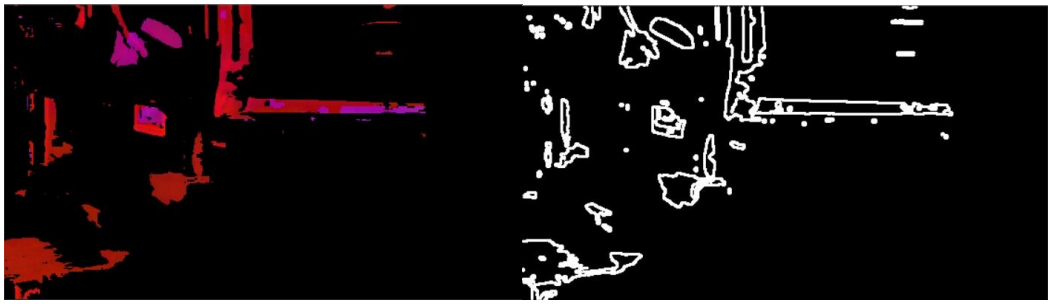

FIGURE 9. The actual processing results

According to these figures, we can find that the difference between the color of the spray interest area and the vehicle body color on the HSV value. And the range of its own value is relatively stable, so we can judge that the method is practicable. In Figure 8, we test every single frame's processing time. It shows that, except the first frame, every frame's processing time is less than 150ms and stable. So, we can almost keep up with pipeline's speed which will become a practical application.

CONCLUSION

The detection algorithm of glue spray on bottom of vehicle based on machine vision uses artificial intelligence to solve the problems encountered in the process of vehicle bottom spraying. It utilizes the technology of machine vision, can save human resources effectively, and connects the camera through the glue machine. It realizes the real-time acquisition of bottom-spraying information of the vehicle and can provide technical support for the future automobile pipeline system.

ACKNOWLEDGEMENTS

This work is supported by Natural Science Foundation of Jilin province (20170101133JC), and Jilin University (5157050847, 2017XYB252, 2017B54499).

REFERENCES

1. Jahanshahi Mohammad R., Jazizadeh Farrokh, Masri Sami F., Becerik-Gerber Burcin, etal. Unsupervised Approach for Autonomous Pavement-Defect Detection and Quantification Using an Inexpensive Depth Sensor[J]. JOURNAL OF COMPUTING IN CIVIL ENGINEERING, 2013, 27(6):743-754.
2. Jahanshahi Mohammad R., Masri Sami F., Padgett Curtis W., etal. An innovative methodology for detection and quantification of cracks through incorporation of depth perception[J]. MACHINE VISION AND APPLICATIONS, 2013, 24(2):227-241.
3. Ho Hoai-Nam, Kim Ki-Deok, Park Young-Soo, etal. An efficient image-based damage detection for cable surface in cable-stayed bridges[J]. NDT & E INTERNATIONAL, 2013, 58(2013):18-23.

4. Jamshidi Ali, Faghih-Roohi Shahrzad, Hajizadeh Siamak, etal.A Big Data Analysis Approach for Rail Failure Risk Assessment[J]. RISK ANALYSIS, 2017, 37(8):1495-1507.
5. Ortiz Alberto, Bonnin-Pascual Francisco, Garcia-Fidalgo Emilio, etal. Vision-Based Corrosion Detection Assisted by a Micro-Aerial Vehicle in a Vessel Inspection Application[J]. SENSORS, 2016, 16(12):2118.
6. Molina Jaime, Ernesto Solanes J., Arnal Laura, etal. On the detection of defects on specular car body surfaces[J]. ROBOTICS AND COMPUTER-INTEGRATED MANUFACTURING, 2017, 48(2017): 263-278.