ISSN: 1813-4890

Research Report on Intelligent Identification of Freight Train Number Based on Graphics Processing Technology

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Abstract

With the booming development of the logistics industry, freight train identification has become an indispensable link in improving transportation efficiency and ensuring logistics safety. Most of the traditional train number identification methods rely on manual operation, which is not only inefficient, but also prone to make mistakes. This paper proposes an intelligent identification method of freight train number based on image processing technology, which integrates advanced image processing technology and machine learning algorithm to realize efficient and accurate automatic identification of freight train number, which has great practical value and significance to the logistics industry.

Keywords

Car number; Image recognition; Intelligence.

1. Introduction

With the rapid development of railway transport, the number identification of freight trains becomes an indispensable link in railway transport management. Traditional car number identification method mainly relies on manual visual inspection, which is not only inefficient and error-prone, but also inadequate in the face of large amounts of data. However, with the rapid development of computer vision and graphics processing technologies, the intelligent identification method of vehicle numbers based on these technologies has gradually emerged, bringing revolutionary changes to the railway transportation management. This report will deeply explore the research status, innovative methods, challenges and future development prospects of intelligent identification of freight train numbers based on graphics processing technology [1-2].

2. Research Status Quo: The Integration of Technology and Innovation

At present, significant progress has been made in vehicle number identification research based on graphics processing technology. By using the deep learning algorithms, especially the convolutional neural network (CNN), the researchers have realized the efficient identification and extraction of the vehicle number characters. By training a large number of car number image data, these algorithms can learn the deep characteristics of the car number characters, and then realize accurate recognition in a complex background. Moreover, some researchers have combined traditional image processing techniques such as filtering, binarization, and edge detection to improve the identification accuracy and stability. The convergence of these technologies has created new possibilities for car number identification, making automatic identification possible [3-4].

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3. Research Method: Refined Processing Process

Vehicle number identification method based on graphics processing technology needs to go through a series of carefully designed processing steps. Firstly, the collected train images are denoised, enhanced and binarized through the image preprocessing technology to improve the image quality and lay a foundation for the subsequent processing [5]. Secondly, image segmentation and edge detection techniques are used to locate the car number and accurately find the position of the car number in the image. Finally, the deep learning algorithm is used to identify the located car number characters and extract the car number information. This process requires a refined operation and rigorous data processing to ensure the accuracy and stability of the identification [6]. The following is the run code obtained from the test:

```
import cv2
import pytesseract
from PIL import Image
# Define the function that identifies the train number
def recognize_train_number(image_path):
try:
# Read the picture
image = cv2.imread(image_path)
# Convert the BGR images to grayscale images
gray_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
# Apply the binarization treatment to highlight the vehicle number
_,binary_image=cv2.threshold(gray_image,150,255,cv2.THRESH_BINARY_INV)
# Expand the vehicle number character with the expansion operation
dilated_image = cv2.dilate(binary_image, None, iterations=2)
# Find the outline
contours,_=cv2.findContours(dilated_image,cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
# Perverse the outline to extract the car number characters
train_number=""
for contour in contours:
# The bounding box of the calculated profile
x, y, w, h = cv2.boundingRect(contour)
# Extract the character image
char_image = image[y:y+h, x:x+w]
# Identify the characters using the OCR library
char_text = pytesseract.image_to_string(char_image, lang='eng')
# Remove the non-numeric characters in the recognition result
if char_text.isdigit():
train_number += char_text
return train_number
except Exception as e:
# exception handling
print(f"An error occurred: {e}")
return None
# Use the example
```

ISSN: 1813-4890

```
image_path = "path_to_your_image.jpg"
train_number = recognize_train_number(image_path)
print(f"Recognized train number: {train_number}")
```

This code implements a recognize_train_number function, which receives an image file path and then identifies the train number in the image through image processing technology and an OCR library. Here are some instructions about the code:

Exception handling: Use the try-except block to capture any exceptions that may occur and provide error information.

Performance optimization: When processing images, the code uses the OpenCV library as efficiently as possible, such as binarization with cv2.THRESH_BINARY_INV, cv2.dilate for expansion operations, and cv2.findContours for finding profiles.

Compatibility: The code uses the OpenCV and Pillow libraries, which are available on multiple operating systems, so the code is very compatible.

Security: There is no obvious security vulnerability in the code because it does not handle any sensitive data or perform any operations that may harm the system.

Readability: The code annotation is detailed, the variables are clear, following the Python programming specifications and PEP 8 guidelines, making the code highly readable.

Note that this code relies on the Tesseract OCR engine, requires the installation of the pytesseract library as well as the Tesseract-OCR software, and needs to ensure that the pytesseract is configured correctly to use the Tesseract-OCR engine. In addition, because train train number identification is a complex task, this code may need to be adjusted and optimized according to the actual situation.

4. Light, Wear and Background Tests

Although the vehicle number identification method based on graphics processing technology has achieved some achievements, it still faces some challenges and problems in practical application. Among them, the light condition is one of the important factors affecting the accuracy of vehicle number identification. Different lighting conditions will have a great impact on the image quality, such as overexposure, overshading or uneven lighting, which may lead to errors in vehicle number identification. In addition, long use and wear may cause blurred vehicle number characters, causing difficult identification work. In addition, the complex background around the train may also interfere with the identification of the vehicle number, such as the shielding and reflection of objects such as other vehicles, buildings or trees.

5. The Exploration of Algorithm Optimization and Multi-modal Identification

With the continuous progress of computer vision and graphics processing technology, the intelligent identification method of vehicle numbers based on these technologies is expected to achieve greater breakthroughs in the future. First, researchers can improve the accuracy and stability of vehicle number identification by improving deep learning algorithms. For example, the use of deeper network structure, the introduction of attention mechanism, enables the algorithm to better learn the features of vehicle number characters and achieve more accurate identification in a complex context. Secondly, with the development of multi-modal recognition technology, image, sound and vibration can be considered in the future. This multimodal identification method can exploit the complementarity of multiple information sources to further improve the accuracy and robustness of identification. Finally, by optimizing algorithms and hardware equipment, the real-time identification of car number is also an important

development direction in the future. This will help railway transport authorities to obtain train information and improve transport efficiency and safety.

6. Conclusion and Outlook

Intelligent identification of freight train number based on graphics processing technology is an important research topic. Although there are still some challenges and problems in the current research, but with the continuous progress of technology and the continuous expansion of application scenarios, I believe that there will be more breakthroughs and innovations in the future. With the continuous optimization of algorithms and the development of multi-modal identification technology, we have reason to believe that the intelligent identification of vehicle numbers based on graphics processing technology will play an increasingly important role in railway transportation management and provide strong support for the safety, efficiency and intelligence of railway transportation.

The intelligent identification system based on graphics processing technology brings great potential to the railway transportation industry. By combining deep learning, image processing, and possible future technologies such as multimodal recognition, we can foresee a more efficient, accurate, and automated train number recognition system.

With the continuous optimization of the algorithm, the future vehicle number identification system will be better able to deal with a variety of complex environmental conditions, such as different light conditions, wear and tear of vehicle number characters, and background interference. In addition, by the introduction of multimodal recognition technology, we can combine image, sound, vibration and other information sources to further improve the accuracy and stability of vehicle number identification.

At the same time, we should also see that the intelligent identification of car numbers based on graphics processing technology still faces some challenges and problems. For example, how to ensure that accurate identification can still be achieved in extremely harsh environmental conditions, and how to reduce the cost and practicality of the system and improve its problems still need us to conduct in-depth research and exploration.

Looking ahead, we look forward to seeing more innovative technologies and methods being introduced into the field of intelligent identification of vehicle numbers, promoting the technological progress and application development in this field. At the same time, we also hope to see more industry cooperation and cross-border cooperation, and jointly promote the application and development of intelligent vehicle number identification based on graphics processing technology in railway transportation management.

In conclusion, the intelligent identification of freight train numbers based on graphics processing technology is a research field full of challenges and opportunities. With the continuous progress of technology and the continuous expansion of application scenarios, we have reason to believe that this field will usher in a broader space for development and a better future.

Acknowledgements

This work is supported by the 2022 National College Student Innovation and Entrepreneurship Training Project of Anhui University of Finance and Economics: "*Research on freight train vehicle number identification system based on image data analysis*" (No.: 202210378316).

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ISSN: 1813-4890

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