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Vehicle VIN Recognition Based on Deep Learning and OCR

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INTRODUCTION & AIM

INTRDUCTION

- The primary purpose of the VIN is to provide a unique identifier for the vehicle, containing basic manufacturing information to facilitate identification, registration, tracking, and maintenance.
- Traditional VIN entry typically relies on manual transcription, which is inefficient and prone to errors due to irregular handwriting.
- Due to the lengthy nature of VIN codes, small font size, and limited research in this area, challenges remain in recognition under complex environments.

AIM

- Propose a VIN recognition solution based on deep learning and OCR, aiming to address the limitations of traditional methods in complex environments.
- By utilizing deep learning technology, this solution extracts character features from images, locates, and recognizes the VIN, thereby enhancing accuracy and robustness.
- Enhance the automation and intelligence level in vehicle and charging card management, optimizing the utilization of company vehicle resources, and providing substantial practical application value.

METHOD

- Image Acquisition and Preprocessing:The Canny edge detection method is used to identify edges in the images, and morphological closing operations enhance the contours of possible VIN regions. Image contours are filtered based on aspect ratio and size to identify regions that match VIN characteristics. The selected regions are then cropped and preprocessed with techniques such as grayscale conversion, binarization, and image enhancement. These steps effectively remove noise, enhance the contrast of key information, and support subsequent character segmentation and recognition.
- Grayscale Conversion: Grayscale conversion transforms a color image into one that contains only brightness information. In this paper, a sharpening process is applied before grayscale conversion to retain key information while reducing computational cost, making it suitable for real-time applications and large-scale processing while effectively preserving brightness features in the image.
- Image Enhancement :Image enhancement techniques improve the visual quality of images, making critical details clearer during subsequent processing. Contrast enhancement, brightness adjustment, histogram equalization, and gamma correction are employed to significantly improve the clarity and recognizability of character outlines, ensuring high VIN recognition accuracy in complex environments.
- Binarization :Binarization converts images into black-and-white pixels, emphasizing contours and shapes. This paper uses adaptive threshold binarization, which dynamically adjusts thresholds based on local features in different regions of the image, effectively preserving more details in varying lighting conditions and reducing the need for subsequent image equalization operations, thereby improving processing efficiency and accuracy.
- Character Recognition :Character recognition is based on the Tesseract OCR engine, combined with an LSTM (Long Short-Term Memory) network to address sequence dependencies and character confusion issues in VIN recognition. Tesseract's character segmentation and the contextual analysis of LSTM ensure accurate character sequence recognition under VIN structure rules, reducing errors caused by similar characters like "O" and "0" and enabling precise VIN extraction.

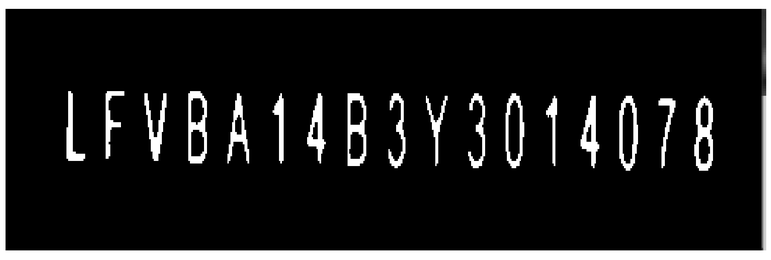
RESULTS & DISCUSSION

Original VIN code image

localization area

grayscaling

image enhancement



binarization

recognition result

CONCLUSION

The article proposes a vehicle VIN code OCR recognition system based on deep learning, addressing the limitations of traditional methods in complex environments. By utilizing high-resolution imaging devices and applying preprocessing techniques such as grayscaling, binarization, and image enhancement, combined with CNN and LSTM models to automatically extract key features, the system achieves efficient and accurate VIN code recognition, enhancing both accuracy and robustness. Results show that the system demonstrates high precision and strong generalization capability under complex conditions, supporting automation and intelligence in vehicle management and charge card administration. In the future, this system is expected to be applicable to scenarios such as vehicle tracking, registration, and maintenance, further optimizing vehicle resource management.

FUTURE WORK / REFERENCES

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