Research on Machine Instrument Panel Digit Character Segmentation

Xiaoyuan Wang, Basic Teaching and Training Center, Hefei City, China*

Hongfei Wang, Sinosoft Company Limited, China

Jianping Wang, College of Electrical Automation, Hefei University of Technology, China

Jiajia Wang, Student Innovation and Entrepreneurship Education Center, Hefei University, China

ABSTRACT

In this study, the authors perform slant correction on fixed-format dial images using the Hough transform, followed by their "scaling" using binary wavelets to achieve coarse segmentation for characters or numbers. Simultaneously, they propose a binary threshold iteration method that accurately determines the position of each character or number even in the presence of adhesion or fragmentation, enabling precise segmentation. They employ their proposed approach to segment digits and characters displayed on 98 fixed-format dials. Experimental results demonstrate a recognition rate of 98.5% for both letters and numbers, highlighting significant practical value and real-world implications.

KEYWORDS

Character Segmentation, Machine Dial Images, Research

INTRODUCTION

In recent years, number and character recognition has been gaining widespread attention in the field of image processing, thanks to the rapid development of digital technology. The segmentation of numbers and characters in dial images is a popular research directions in this field. Dials are widely used in instruments, automotive dashboards, and other fields, making it essential to accurately segment numbers and characters for improving recognition accuracy and practical applications. This study aims to achieve precise segmentation of characters and numbers in dial images using methods such as the Hough transform and binary wavelets, providing effective technical support for related applications (Fu et al., 2001).

There have been noteworthy research results in the field of digit and character segmentation, we present an overview of noteworthy research results in the field of digit and character segmentation from 2021 to 2023, covering various methods and techniques. The method proposed by Li and Dong (2022) utilizes a segmentation approach based on nearest neighbor values and prior knowledge of license plate characters to obtain the first five complete characters of a license plate. The remaining five characters of the license plate are obtained through character concatenation based on an enumeration method, achieving a complete license plate segmentation.

*Corresponding Author

Wang and Li's (2023) method first used ROI regions and then connected component processing algorithms on images of exam paper score columns, which are acquired using a high-resolution scanner. The abbreviation "ROI" stands for "Region of Interest," referring to specific areas in an image or graphic that are of particular interest or focus for processing. This process extracts handwritten scores, forming individual images, which are then normalized and formatted into a CSV file. These data are fed into a pre-trained LeNet-5 network for recognition. During the training of the LeNet-5 network, parameters such as batch size, learning rate, epochs, and weight quantities are continuously adjusted, resulting in a recognition accuracy of 93.2% (Wang & Li, 2023).

In this study, we first use the Hough transform to perform skew correction on dial images with fixed formats. Subsequently, we employ binary wavelets to "scale" the images, achieving coarse segmentation of characters or numbers. Additionally, we propose a binary threshold iteration method to accurately determine the position of each character or number even when it undergoes adhesion or fragmentation, which results in precise segmentation. The results show that the proposed method achieves a recognition rate of 98.5% for both letters and numbers in 98 fixed-format dial images, validating its efficiency and accuracy. It can provide strong support for the practical application of character and number segmentation technology.

CHARACTER SEGMENTATION TECHNOLOGY

Introduction to Character and Number Segmentation Technology

Overview of Character Segmentation Techniques

A core aspect in character recognition systems is that most of the existing recognition methods focus on isolated character recognition. An essential aspect of character recognition is character segmentation, and incorrect character segmentation directly leads to character recognition errors. Therefore, character segmentation technology is essential for successful character recognition (Zheng et al., 2021). Character segmentation is defined as the technique of decomposing an image containing a character sequence into sub-images with isolated characters. It emerged in the 1970s when a single-character image database was used as the recognition target. Due to insufficient recognition of the importance of character segmentation in commercial applications, the development of character recognition systems remained stagnant at this stage and did not receive a significant amount of attention. In the 1980s, with the increasing commercial applications and widespread attention dedicated to character recognition, research on character segmentation technology underwent extensive and in-depth development (Qian & Bai, 2021).

Generally, in character recognition systems, there are handwritten and printed characters based on different recognition processing objects. Since the 1970s, various character segmentation methods have emerged, such as region segmentation, merging, and projection. The distinction between printed and handwritten characters lies in the fact that the former use fonts or similar fonts during printing. Printed text is relatively standardized along both horizontal and vertical orientations, making it widely applicable. On the other hand, handwriting is practiced by people in their daily lives, and handwritten text cannot be passed down and processed without printing technology (Hu et al., 1999).

Progress of Character Segmentation Technology

The printed and handwritten character texts require segmentation of fixed-spacing text, segmentation with sticky characters. The cropping method based on vertical projection is a technique for segmenting text with fixed character spacings. This method can segment each text into characters, ensuring that the resulting segmented text conforms to the character text without any breakage, adhesion, or other phenomena. However, in reality, the presence of adverse conditions like noise makes it rare to encounter text that is not fragmented or stuck together. Therefore, it is necessary to study feature segmentation under fragmented and adhered conditions (Liu et al., 2022).

Related Content

Toward an Interdisciplinary Engineering and Management of Complex IT-Intensive Organizational Systems: A Systems View
Manuel Mora, Ovsei Gelman, Moti Frank, David B. Paradice, Francisco Cervantesand Guisseppi A. Forgionne (2008). *International Journal of Information Technologies and Systems Approach (pp. 1-24).*
www.irma-international.org/article/toward-interdisciplinary-engineering-management-complex/2530

A Study of Sub-Pattern Approach in 2D Shape Recognition Using the PCA and Ridgelet PCA
Muzameel Ahmedand V.N. Manjunath Aradhya (2016). *International Journal of Rough Sets and Data Analysis (pp. 10-31).*
www.irma-international.org/article/a-study-of-sub-pattern-approach-in-2d-shape-recognition-using-the-pca-and-ridgelet-pca/150462

Usability Evaluation of the Tablet Computer 'Aakash-2'
Ganesh Bhutkar, Manasi Patwardhanand Dhiraj Jadhav (2015). *Encyclopedia of Information Science and Technology, Third Edition (pp. 1153-1169).*
www.irma-international.org/chapter/usability-evaluation-of-the-tablet-computer-aakash-2/112511

Human Supervision of Automated Systems and the Implications of Double Loop Learning
A.S. White (2013). *International Journal of Information Technologies and Systems Approach (pp. 13-21).*
www.irma-international.org/article/human-supervision-of-automated-systems-and-the-implications-of-double-loop-learning/78904

The Measurement and Recognition of Intellectual Capital in the Process of Accounting Convergence Trends and Patterns
Ionica Oncioiu (2018). *Encyclopedia of Information Science and Technology, Fourth Edition (pp. 5669-5678).*
www.irma-international.org/chapter/the-measurement-and-recognition-of-intellectual-capital-in-the-process-of-accounting-convergence-trends-and-patterns/184267