

The Field of Intelligent Recognition that be Advance by Machine Learning

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Abstract. Over the past few years, there has been a sharp increase in software projects using artificial intelligence and machine learning. Although artificial intelligence (AI) and machine learning (ML) are often used interchangeably, they are not the same. With the development of artificial intelligence and machine learning, technologies have gradually become an indispensable part of people's life. In this essay, the recognition pattern will be mentioned as well as optical character recognition (OCR), intelligent character recognition (ICR) and intelligent word recognition (IWR). And we can easily find that all these three kinds of recognitions have been completely integrated into our daily lives, and convenient our life a lot. The comparison of these three recognitions will also be mentioned in this essay, like what are the differences in performances and usages between them. What's more, we also can learn the process of these three recognitions.

Keywords: artificial intelligence (AI), machine learning (ML), optical character recognition (OCR), intelligent character recognition (ICR), intelligent word recognition (IWR).

1. Introduction

As the most common of the seven artificial intelligence patterns, recognition patterns have been used in all aspects of people's lives, but also deeply affect People's Daily life. And one of these technologies is recognition pattern a method for analyzing data that can automatically identify patterns and regularities in data by using machine learning algorithms. We use machines to help identify and classify all kinds of structured and unstructured data (like images, videos, text, or even quantitative data, etc.) in specific types, which is the main idea of Intelligent Recognition. The greatest power of intelligent recognition lies in that it can do things as simple as the human brain and present the real world around us completely [2].

Notably, intelligent recognition brought people into the in-depth study of artificial intelligence and aroused people's interest in artificial intelligence. We can also use artificial intelligence to recognize and understand unstructured data, like images, voices, handwriting, objects, faces, gestures, and so on [2]. Nowadays, a huge number of different types of intelligent recognition software and systems are applied in our daily life.

As far as I know, we have already developed Optical Character Recognition (OCR), Intelligent Character Recognition (ICR), Intelligent Word Recognition (IWR), Intelligent Image Recognition, Object Recognition, Voice Recognition (Speaker Recognition), etc. All the recognitions have a wide range of applications, from medical imaging to self-driving cars, from handwriting recognition to facial recognition, speech, and speech recognition, and even the most detailed things in all types of videos and data [2] and bring convenience in people's daily life.

2. Traditional methods

Traditional Optical character recognition can be seen as the most basic and typical machine learning and computer vision task which is already out of date but still widely used in our daily life.

Optical character recognition or optical character reader (OCR) is the typing, written or printed text image converted into machine code in the form of electronic or mechanical text, both in terms of scan files, files, photos, the scenery pictures, such as landscape photos of logo and the words on the

billboard) or image on the subtitle text (such as television and radio) [3]. Shortly, OCR is a kind of software that scans text file and translates it into digital forms.

OCR as an area of research in pattern recognition, computer vision, and artificial intelligence, is widely physically used in recording data, like paper files, invoices, bank statements, computerized receipts, traveling through an airport, sending a letter in the mail, or depositing a check in the ATM. We can also easily find the applications of OCR engines in our days, such as receipt OCR, invoice OCR, check OCR, legal billing document OCR [3].

Earlier versions required training using images of each character and using only one font at a time. Advanced systems that produce high recognition accuracy for most fonts are now common and support input in a wide range of digital image file formats. Some systems can reproduce formatted output that closely resembles the original page, including columns, images, and other non-text components [3]. With the combination of OCR with artificial intelligence and machine learning techniques, they have become more accurate at converting text and checking for errors in the process [5].

The system of OCR works in three steps [5]:

- 1) Image Pre-processing
- 2) Intelligent Character Recognition
- 3) Pattern recognition
- 4) Feature extraction
- 5) Post-processing

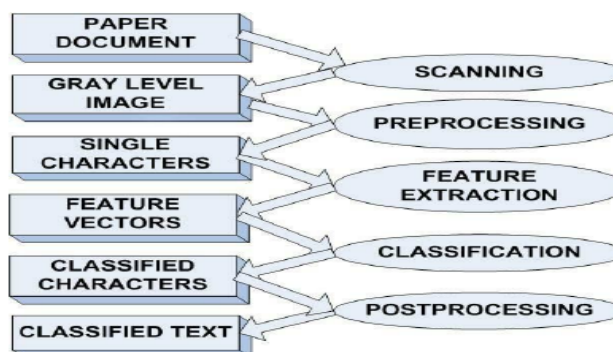


Figure 1. Basic-Steps-of-an-OCR

3. New machine learning-based methods

In computer science, Intelligent Character Recognition (ICR) is an advanced optical character recognition (OCR), or more specifically, it is a kind of handwriting recognition system that allows a computer to learn fonts and different styles of handwriting during processing to enhance accuracy and recognition independently [6]. Shortly, Intelligent Character Recognition (also known as ICR) is software that can identify fonts and styles of handwriting [4].

ICR can also be seen as the combination of machine learning algorithms and AI that facilitate some aspects of people's daily lives [7]. For example, ICR technology can transform paper-based information into a digital one and store it on our computer which helps people to organize unstructured data easily. The combination of ICR and OCR engines catches the form data automatically and eliminates the need to type data. It has high accuracy and is a reliable method to save time processing various documents [7].

Most ICR Softwares have a self-learning system called neural networks that automatically updates the recognition database to identify new handwriting patterns [6]. This means that every time the ICR encounters a note-taking handwriting pattern that is not present in the neural network, it will automatically upgrade its recognition database. With the accumulation of each data set, the learning notes of the neural network become more and more, and the accuracy rate of the recognition notes also increases. However, due to the unwell-structured handwriting, the accuracy may not be great in some cases, but it can be more than 97 percent accurate when reading structured handwriting. To

keep a high recognition rate, people always use several reading engines and each of them with a selective vote to determine the final recognition result. In different fields, the engine will preferentially select the engine corresponding to the character type. For example, in a number field, the engine that reads numbers is given priority, while in a character field, the engine that reads handwritten letters has higher selection privileges.

The process of the ICR system can be shown in the figure below,

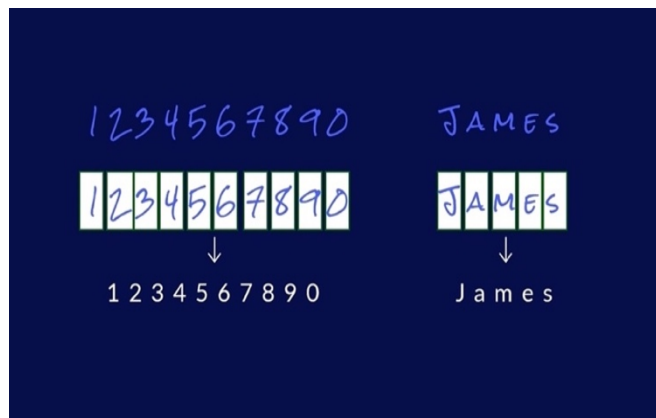


Figure 2. The process of ICR



Figure 3. One of the handwriting styles

As the process is shown above, we can easily divide it into three steps also,
Scan and get the digital handwriting content

Divide each alphabet and number into small blocks and match the corresponding content in the neural networks (if the handwriting style cannot be found in neural networks, ICR software will learn the new handwriting style and upload it to neural networks)

Translate into digital and well-structured forms which can be easy to understand by all of us

4. Comparison on performance and usage

The most striking difference of usage between ICR and OCR is ICR is usually used to recognize handwriting, while OCR is usually used to convert printed paper documents into text for searching and sorting. OCR text can also be copied and pasted. ICR, on the other hand, is particularly concerned with handwritten or printed material that uses complex fonts that OCR cannot handle [9].

OCR is cheaper than ICR and can only identify printed paper documents and convert them to electronic versions. However, ICR can recognize a variety of versions of handwriting styles and fonts and learn handwriting styles that weren't in their neural networks to improve the accuracy of recognition. Although ICR is much more expensive than OCR, ICR can do whatever OCR does [9].

In addition, if you use it in conjunction with other technologies such as scanning and file compression, OCR will produce editable and searchable documents while being fast, simple, and accurate. Using OCR speeds up the workflow within an organization by never having to manually correct or search multiple pages. OCR also works with computer speech tools, making it a convenient

access tool. If your job is to write notes and manuscripts by hand, you'll need more intelligent character recognition [8].

In terms of recognition content, OCR only has a fixed and limited font database. But the ICR includes a neural network that allows the software to update the data and learn any new fonts and handwriting styles to increase the accuracy of character recognition [8].

5. The potential direction of advancement

Intelligent Word Recognition (IWR) is the unconstrained recognition of handwritten words by recognizing handwritten or printed words or phrases from a user-defined dictionary. IWR significantly reduces the character errors encountered by typical character-based recognition engines. For instance, when using OCR to extract the word “cat”, the word will be recognized separately as “c”, “a” and “t”. However, the letters can be matched to the dictionary as an entirety by IWR “cat” based on pattern recognition and various algorithms.

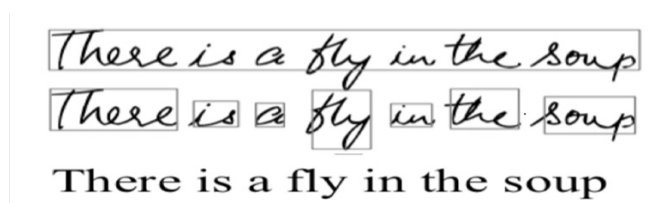


Figure 4. The process of the IWR

Shortly, the process of the IWR is recognizing the whole handwriting words and matching the whole words in the dictionary straightforward, then translating the whole words into digital form.

The availability of the technology is limited to defined areas. For example, it was developed by a French manufacturer of text recognition systems to check reading systems, and its layout contains a field to allow the amount of written payment for continuous text. This domain has a restricted list of words, so a fully trained classifier can provide reliable results [11].

The limitation of the IWR is that manuscripts vary widely. The larger the underlying dictionary, the more likely it is that unambiguous results are no longer available [11].

6. Conclusion

In conclusion, machine learning brings us a huge convenience in both businesses and our daily routine. Machine learning has a powerful ability to recognize or match patterns that appear in data. Recognition system, as the most typical and basic system in machine learning, has been widely used in all aspects of life. For example, the new iOS recognizes and reads the text in pictures, object recognition for autonomous vehicles, facial recognition for payments, Music applications uses voice recognition to identify tracks, and so on.

From Optical character recognition (OCR) to Intelligent character recognition (ICR), then to Intelligent word recognition (IWR) and other recognition systems, machine learning and artificial intelligence are bringing huge positive changes to recognition systems. Every upgrade to the recognition system is the result of machine learning.

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