Multilanguage On-line handwriting recognition review

Nowadays, the world is getting more and more digitalized. Almost all the information and data are stored as numbers and the other forms of digital signals. And people are also trying to store information quickly as possible as digital forms because it is easier to preserve and more portable than the original forms. Therefore, an efficient and accurate handwriting recognition system is very important for us. However, traditional on-line handwriting recognition is slow and inaccurate. In Google's paper, they discussed how they manage to increase the efficiency of the on-line handwriting recognition and its accuracy.

The paper first discusses what on-line handwriting recognition is: an on-line handwriting recognition system is the ability of a computer to interpret intelligible handwritten input. Even though this technology has been developing throughout the last 20 years, there are still some challenges that the traditional handwriting recognition system faces and those challenges are: strong variability in writing style, ambiguous input, large amount of input and non-monotonic relationship to output caused by delayed (2, Keysers). Then it starts proposing its own on-line handwriting recognition system's architecture and recognition process which are preprocessing, segmentation and lattice tree creation, scoring character hypotheses and best path search in resulting lattice. In preprocessing step, it roughly resampling the space and angle of the strokes and make them into points to digitalize the length. When creating the lattice, it looks like it is constructing the lattice into some state machine diagram and giving the weight for each different path notating different orders and ways of writing for each segments. For the last step, searching through the lattice tree based on the weight for each segment node to get the correct result for recognition.

The main idea of their implementation of the on-line handwriting recognition system is to increase the speed of the process by pruning the size of decision tree. In preprocessing step, it only applies resampling and slope correction instead of doing more preprocessing, for example noise filtering and slant correction. While creating the segmentation lattice, heuristic methods reduces the lattice as much as possible so it is more efficient when doing the search in the later steps. In search step, 5 pruning strategies are applied. What these strategies do are mainly reducing the search tree and prune the beam search algorithm to make it more to limit the decision.   Another important issue that has constantly been mentioned is the tradeoff between efficiency and accuracy. Since the whole system applies the neural network classifiers to give the machine a learning process during the recognition. They only created a single, fully connected hidden layer to classify the handwritings. As the number of the layers of neural network increases, the accuracy in creases but not as much as expected and dramatically decrease the efficiency, therefore they only choose one layer of neural nets to help classify the characters. Another important part of the paper is how feature weight set up and how the training data goes with so many different languages and different characters. They use MERT weight training to assign weights to edge of the lattice. As of the method of collecting training data, they just ask volunteers to write on the mobile device, and then they use some artificial

inflation algorithms to create more various data from the original data collected from volunteers.

Last, they show the result of their on-line handwriting recognition system and it turns out that the system has improved a lot in both efficiency and accuracy compared to previous ones. However, error still occurs when the handwriting is too ambiguous. The paper concludes that through their methods, the system is able to recognize overlapping writing and handle delayed writing. The system is efficient enough to be run on more low power device while still maintain the accuracy.

Work Cited

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