Chinese Character Assisted Learning

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1) Abstract

When learning how to write Chinese characters there is a specific stroke order that needs to be followed. Here we construct a digital assistant to aid in helping a person interested in learning how to write either traditional or simplified Chinese characters. How the system classifies the user's attempts is covered as well as the data used to train the classified.

2) System

As a learning assistant the system must be able to walk users through the correct stroke order for each character. While guiding the user each step needs to be evaluated to indicate how well progress is being made. This is done through an interface (Figure 1) where a user attempts draw a each stroke for a desired character while the system uses a logistic regression classifier to identify how confidently the user is correctly drawing the shown stage.

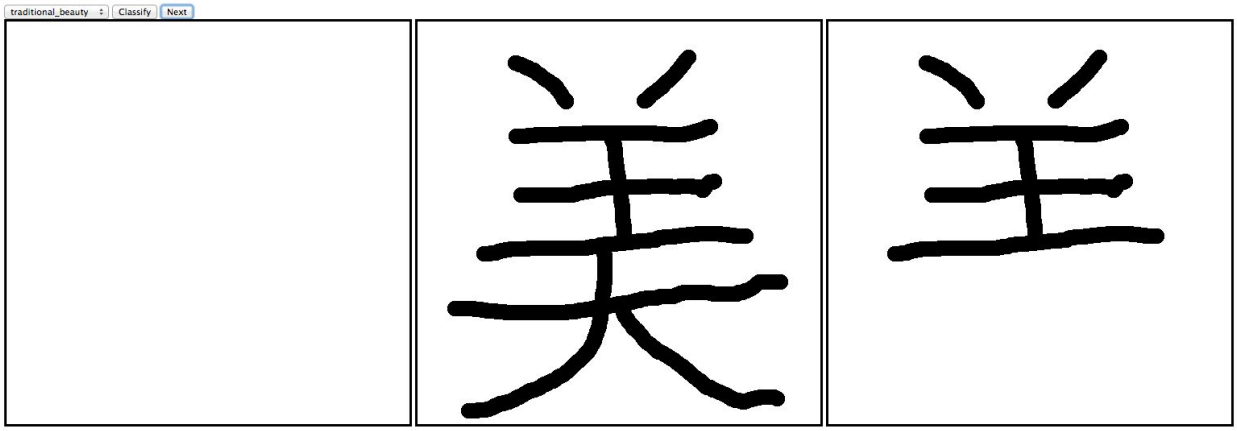

Figure 1: The interface used to train a user. On the left is an empty canvas that can be drawn on to attempt creating the chosen character. In the middle is the desired character being learned. On the right is currently what the user's input should be mimicking as each successive stroke is added in.

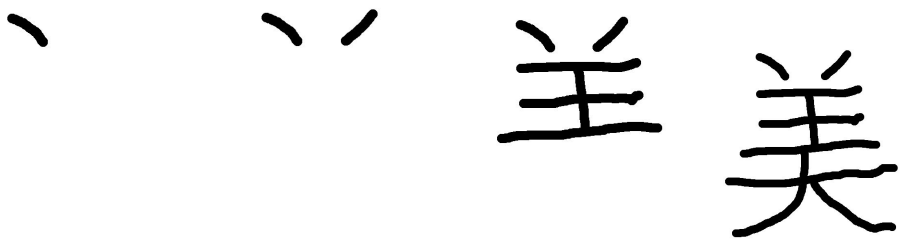

Figure 2: Some images generated from the character for “Beauty” written in traditional. From left to right, one completed stroke, two completed strokes, six completed strokes, complete character.

To create the training data for the logistic regression classifier each character was first separated into its partially drawn stages from the first stroke to the fully completed character (Figure 2). After creating separate images they are rotated and translated where the angles and pixel amounts are sampled from a Gaussian distribution to simulate variability. The original images are a 500 pixel wide by 500 pixel high image that are then downsampled to a 28 pixel wide by 28 pixel high image. These images are then turned into the 784 dimensional feature vectors used for training.

3) Future Improvements

Each stage whether data generation, classification, or the user interface can be improved.

Data generation can be improved in two ways - retaining user attempts and using a different generation method. Translating and rotating a base image creates some level of variability, but this can be improved by using Bayesian Program Learning [1] to better learn each character’s structure and create new images. Currently each user’s attempts are used for classification and then discarded when they can be used as additional samples to train and improve the classifier.

The interface only gives feedback on how well the user matches the current partially completed character. This feedback would be more helpful if it also indicated where the user’s input diverged from the expected input such as with deconvolving a convolutional network filter [2].

4) Future Use

The value in a system is both in what it is used for and what it lays the groundwork for. One objective is for the system to aid in learning to write Chinese characters. The other objective is to use this as a starting point for future engineering and experiments.

With a system that records the strokes a user make the next step is to combine it with a system that tracks where the user's awareness is in deciding where to make a stroke. Instead of learning to draw Chinese characters which have a predetermined order the user would draw faces or other objects. By recording where the user is looking when sketching an object and comparing it to when and what the user chooses to sketch we would attempt to identify points of focus used in creating a mental model that is then projected onto the paper.

References:

[1] B. M. Lake, R. Salakhutdinov, J. B. Tenenbaum, Human-level concept learning through probabilistic program induction. *Science*. **350**, 1332-1338 (2015).

[2] M. D. Zeiler, R. Fergus. Visualizing and understanding convolutional networks. *Computer Vision-ECCV 2014*, 818-833. Springer, (2014).