Collaborative Drawing With Neural Networks

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Overview

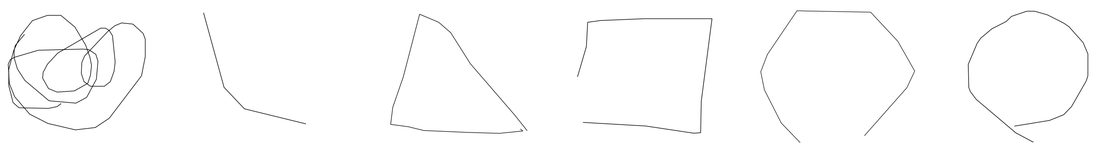
Design tools in packages such as those produced by Adobe and Autodesk have, for many years, been passive in nature. However, with the advent of new machine learning models, research into making them more intelligent has begun [1]. This project looks at applying these techniques to hand drawn images such as those produced by a pen tablet.

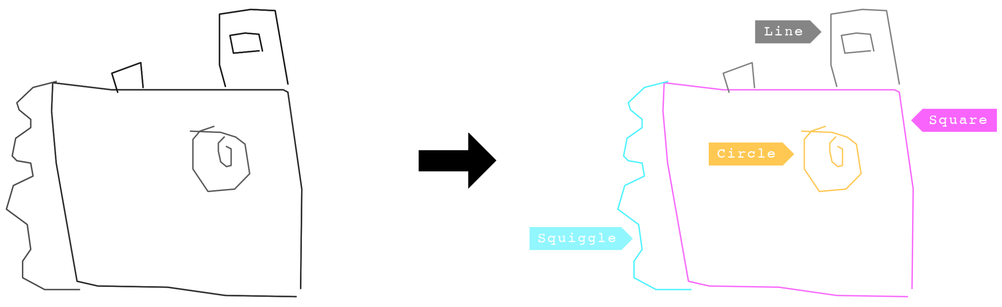
Dataset

Google's 'Quick draw' data set is used to train the models. The recently released data consists of 50 million hand drawn images from 345 classes such as 'Camera', 'Zigzag' or 'Wristwatch'. These drawings come from people with a wide variety of drawing expertise.

The data represents not only what people imagine when they consider one of the class labels but also gives insight as to how people approach drawing and analysis has already begun on peoples drawing styles [2].

Automatic shape detection





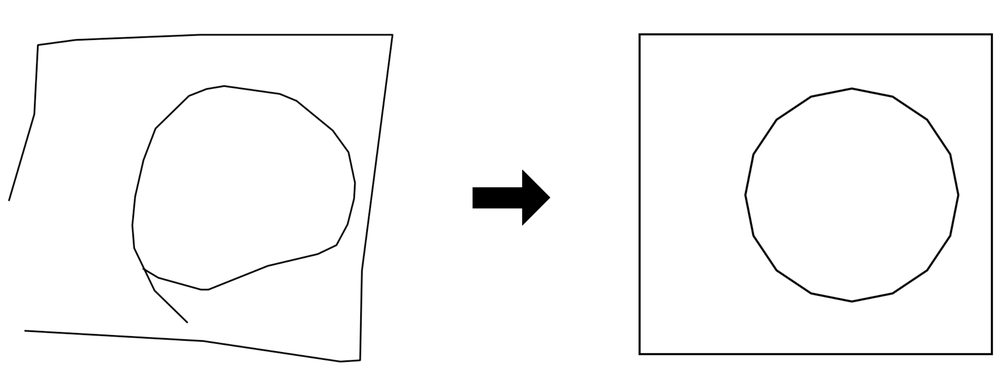
After training a model on the above primitive shape classes, it is given input from the individual strokes of a more complex drawing from the 'Camera' class. The model identifies the most likely shape represented by each stroke and labels it appropriately.

Approach

A model is designed to recognise aspects of peoples drawing habits and probabilistically suggest corrections. The model is built around three network architectures which are combined into a single model that can be trained end to end.

Long Short Term Network (LSTM) : A recurrent neural network capable of learning long-term dependencies [3].
Convolutional Neural network (CNN): A feed forward neural network, particularly adept at image recognition.
Mixture Density Network (MDN): A network which allows training to probability distributions rather than concrete classes [4].

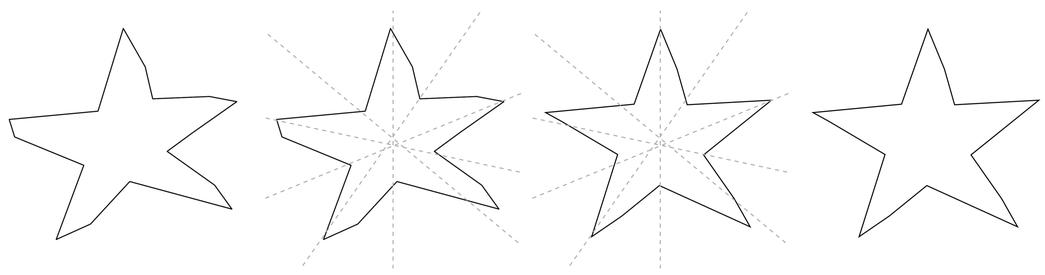
Correction based on shape



Once primitive shapes are identified, a rudimentary correction can be trivially applied by deducing the scale of strokes and replacing them with idealised primitives.

Proposed trajectory

Symmetry detection and correction



The shape recogniser is limited by the requirement to train its model on each class prior to recognition. By training the model on more abstract yet prevalent features such as symmetry we hope to be able to correct novel shapes without explicit training or knowledge about the intended shape. Above we illustrate the proposed approach for a star shape for which there are five symmetries. Using this approach we aim to capture and correct features such as:

- Shape
- Symmetry
- Spacing
- Alignment

Aims

- Develop a model to recognise features such as shape, symmetry etc.
- Use these features to guide static corrections.
- Have the network generate dynamic suggestions in real-time.
- Integrate into tools to aid with drawing.

References

[1] Li Yi, Leonidas Guibas, Aaron Hertzmann, Vladimir G Kim, Hao Su, and Ersin Yumer. Learning hierarchical shape segmentation and labeling from online repositories. *arXiv preprint arXiv:1705.01661*, 2017.

[2] Quartz. How do you draw a circle? Online; accessed 35th March 2018.

[3] Sepp Hochreiter and Jürgen Schmidhuber. Long short-term memory. *Neural computation*, 9(8):1735–1780, 1997.

[4] Christopher M Bishop. Mixture density networks. 1994.