Text Recognition and Machine Learning: For Impaired Robots and Humans

Name	Degree/Position	Year	Supervisor
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Supported By: Canada, MOTOROLA

Motivation

- For robots to collaborate with humans and react to unwanted situations in production environment.
- To prevent damage and injury with machines using optical text recognition (OCR) programming.

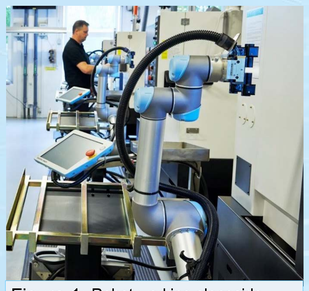

Figure 1: Robot working alongside humans in manufacturing setup (Universal Robots).

Figure 2: Assessing the VF 2TR* in the LIMDA lab (University of Alberta).

Objective

- To assess different machine learning algorithms for text recognition used in manufacturing.
- Implement and test a neural network against a dataset of handwritten examples of characters in the English alphabet.

Figure 3: Example of the keys that are desired to be recognized.

*The VF 2TR is a subtractive manufacturing machine with Computer Numerical control (CNC).

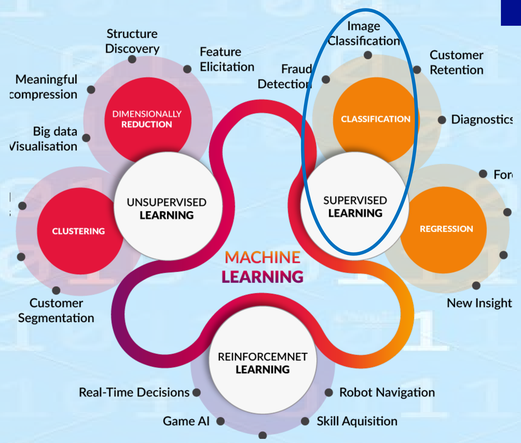

Figure 4: Step one of Method - Identify the type of machine learning for the task. (COGNUB).

Methodology

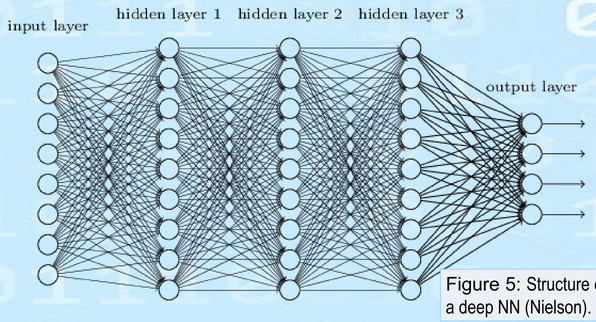

Figure 5: Structure of a deep NN (Nielson).

The form of image classification called Neural Networking (NN) imitates the process of the human brain and uses the information from the input layer to feed forward through layers to determine which answer on the output layer is correct.

Convolutional Neural Networks (CNN's) build on the concepts from neural networks by considering all the information in a specific region of an image and linking the data together to predict if patterns are being formed.

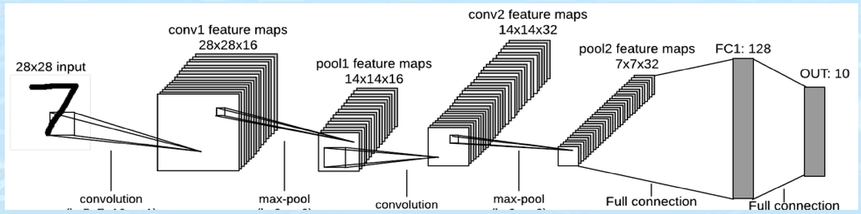

Figure 6: Structure of a CNN (EasyTensorFlow).

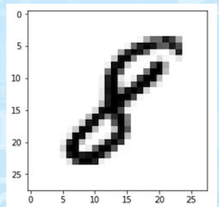

Figure 7: Example of the MNIST digits used to test prototype networks.

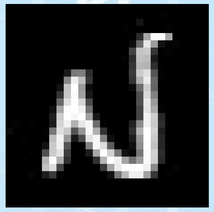

Figure 8: Example of the dataset used on final network (Patel).

Results

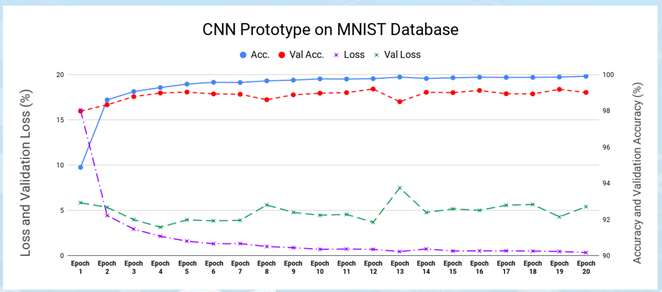

Figure 9: Line graph of the relationship between Loss function and Accuracy on prototype CNN (Sharma).

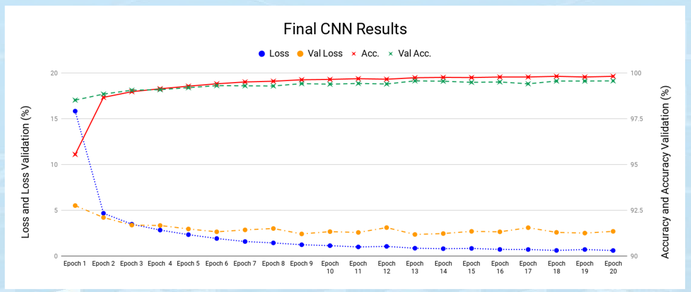

Figure 10: Line graph of the relationship between Loss function and Accuracy on final CNN (Patel).

- Using machine learning libraries like Tensorflow, Keras and Numpy, the slight variations in layer variables between the similar CNN's created a network with an average of 99.3% accuracy and an average 3% loss from the cost function.
- The learning curve of the networks both prove that improvement levels out between 10-15 epochs (training tests), less epochs needed for adequate results means less time wasted running tests.

Future Research

Future testing can determine if this CNN can be useful in the lab.

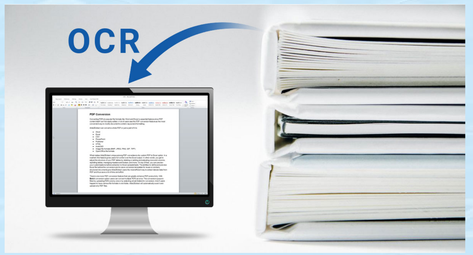

Figure 11: Document transfers to cyberspace (Investintech).

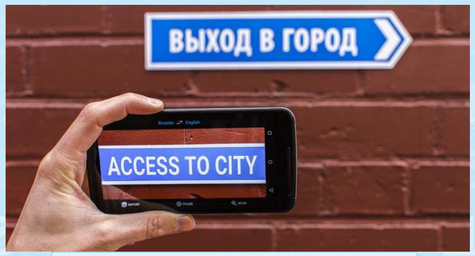

Figure 12: OCR's translating in real time (Verdugo).

Figure 13: Portable voice stick made with OCR to instantly translate text to audio for the visually impaired (Park).

References

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