

Image Processing Assignment 3

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MONASH University

Group: A08

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Table of Contents

1. Task Allocation	3
2. Methodology	3
2.1 Segmentation of Car plate Number	3
2.2 Artificial Neural Network	4
3. Test Result	5
3.1 Assumptions	5
3.2 Segmentation.....	6
3.3 ANN test result.....	6
4. Potential Improvements.....	6

1. Task Allocation

Task	Work By	Responsibilities
Cropped characters	Felicia Malini, Tam Li Yen	Manually cropped 160 images for training and 40 images for testing
Segmentation of car plate	Khor Jun Yong, Tam Li Yen, Felicia	Implementation
Implementation of Artificial Neural Network(ANN)	Khor Jun Yong	Implementation
Quality Testing	Khor Jun Yong, Tam Li Yen	Find the best accuracy through manipulate the parameter in ANN such as the number of hidden neurons, size of images, and learning rate
Report	Khor Jun Yong, Tam Li Yen	Write methodology used in segmentation and ANN

2. Methodology

2.1 Segmentation of Car plate Number

The main methodology used in segmentation is the grouping of pixels connected to each other through the utilization of a cv2's function known as cv2.connectComponent(). From the result, we will get to know each potential candidate along with their positions, width, height and area. To eliminate the noises, we applied some filtering process based on area and width-height-ratio on each of the candidates.

For cleanliness purposes, we have created new folders to store the letters for each of the car plates. After creating the directories, we saved the letters obtained from each car plate into the folders via cv2.imwrite() functions.

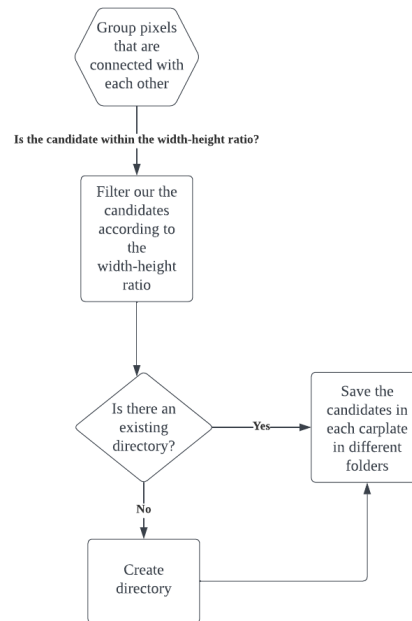


Figure 1: Flow Chart of Segmentation Process

2.2 Artificial Neural Network

A fundamental component in our team's ANNs is the activation function, also known as sigmoid function. This function processes the inputs which are passed into a neuron and generates an output, within the range of 0 and 1. It is important to the network as it ensures the neurons can be activated and facilitate learning in the network even if there are no inputs data for that neuron.

In order to train the neural network, we had applied forward propagation that aims to calculate the outputs that propagate throughout the three layers: input layer, hidden layer, and output layer. After that, we will calculate for the error from the output from output layer by comparing the difference between the target value. If the error is larger than expected, backward propagation is carried out to adjust the weights and biases in each layer. Backward propagation works by calculating the derivative of the weights and biases for each layer through loss function. Loss function is a function that is used to calculate how far the predicted output differs from the actual output. Last but not least, the weights and biases is updated accordingly by subtracting current weight with the product of derivatives of weights with the predefined learning rate.

The forward propagation and backward propagation are run repeatedly until a predefined iterations have been met or the errors are within a tolerance value.

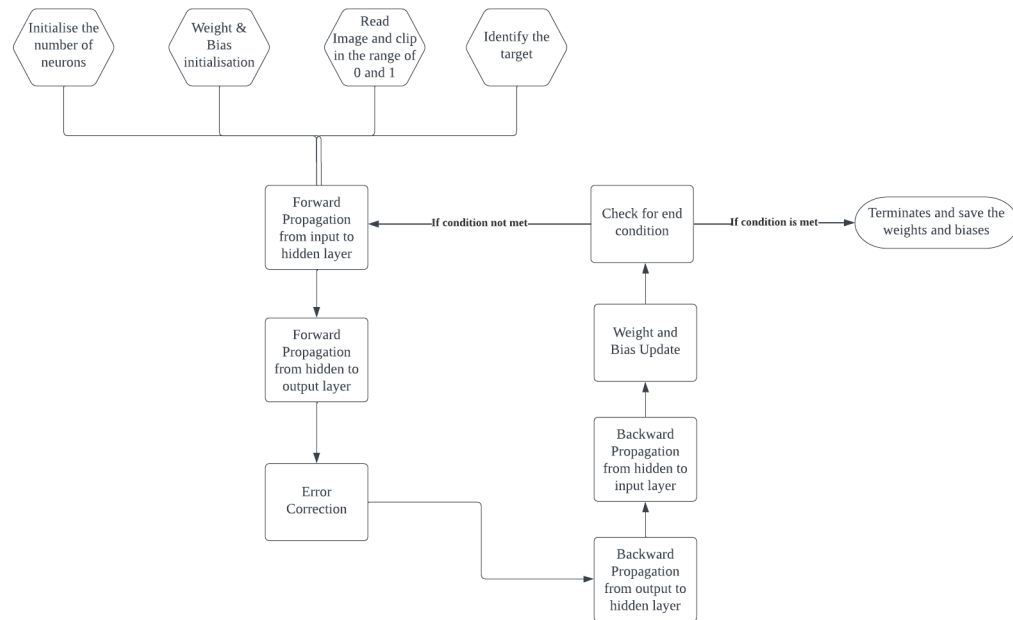


Figure 2: Flow Chart of Artificial Neural Network (ANN)

3. Test Result

3.1 Assumptions

- In our implementations, we assume that the python files must be in the same directory as the data that are meant to be used in the program.
- The naming of folders and images must follow in a certain format such that the ANN program can identify the target without the users providing manually.
- After segmentation of car plate, the naming of images must change manually by the user. The purpose of it is that the user does not have to run multiple lines of code in the ANN program to specify the expected target for each of the images.
- There are 10 car plates to be segmented so there will be 10 folders created to store each of the segment's characters of each car plate.

3.2 Segmentation

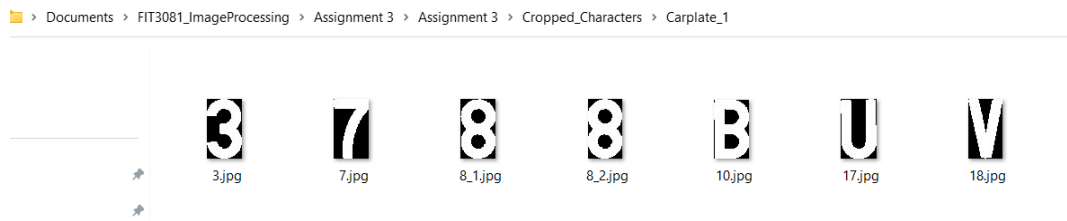


Figure 3: The segmented characters for car plate “1.jpg” provided by teaching team.

(Note: The rest of the segmented characters from other car plate are automatically saved in a different folder with the name “Carplate_2”, “Carplate_3”...etc.)

The segmentations accuracy is 100%, meaning that the program successfully cropped a total of 69 over 69 characters from the provided car plates.

3.3 ANN test result

The accuracy of ANN tested with the testing data is around 40%. For cropped character that was obtained with the segmentation program, we had the accuracy around 49%. Before testing, the user must make sure that the naming of the images is changed according to the naming format specified.

```
...
Test img is:
test_data/19\009.png
The predicted is: 13 The target is: 19
The accuracy is: 0.4
Output is truncated. View as a scrollable element or open in a text editor. Adjust cell output settings...
```

Figure 4: The result of testing with testing data

```
Test img is:
Cropped_Characters/Carplate_10\7.jpg
The predicted car's character is: 7 The target is: 7
The accuracy is: 0.4927536231884058
Output is truncated. View as a scrollable element or open in a text editor. Adjust cell output settings...
```

Figure 5: The result of testing with the segmented characters

4. Potential Improvements

There could be several improvements to increase accuracy. The first improvement is the choices of parameters. This includes the size of hidden neurons, the reshaped size of the image, the learning rate and the quality of training data. Although increasing the size of the hidden neurons might increase the accuracy, it leads to a very long running time of the program.

The next improvement is the training data. Since the training data cropped manually, inevitably there consists of some noise with varies sizes from different angle. Since there is no consistency, the learning process of ANN is affected.