**My capstone project: ID Verification**

The problem to solve:

A shortage of human resources and congestion in the airport.

How it works:

A passenger will stand in front of the camera showing his/her passport photo next to his/her face. The system will compare the face against the photo to verify the ID. If the system verifies that the face and photo are of the same person, green rectangles appear around the faces and the text, “Verified”, appears on the screen. If the system cannot verify, red rectangles and the text, “Not Verified”, appear.

The data used:

Photos download from <http://vis-www.cs.umass.edu/lfw/> and several websites

375 positive and 375 negative pairs (750 in total) prepared for training and testing

115 positive and 115 negative pairs (230 in total) prepared for validation

The datasets includes females/males and black/white/Asian people relatively equally

The training and testing datasets randomly selected from 750 pairs (training: 600 and testing: 150)

Approach:

- Deep learning

- Supervised classification

- Siamese network that uses the pre-trained VGG16 model as a convolutional neural network

Metrics to evaluate the performance:

Recall and Precision

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Test | | Validation | |
| Recall | Precision | Recall | Precision |
| Epoch 10 | 1 | 1 | 0.765 | 0.591 |
| Epoch 20 | 1 | 1 | 0.738 | 0.617 |
| Epoch 50 | 0.695 | 0.658 | 0.777 | 0.594 |

To improve the accuracy, attempted the following fine-tuning options with 50 epochs:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Test | | Validation | |
| Recall | Precision | Recall | Precision |
| 1. 1st dense layer - relu | 1 | 1 | 0.770 | 0.510 |
| 2. Dropout 0.2 after dense layer | 1 | 1 | 0.218 | 0.673 |
| 2-1 Dropout 0.5 after dense layer | 1 | 1 | 0.747 | 0.596 |
| 3. 2 dense layers | 1 | 1 | 0.746 | 0.596 |
| 4. 1st dense – relu; Dropout 0.2 | 0.923 | 1 | 0.385 | 0.627 |
| 5. 2 dense layers; dropout 0.2 after dense | 0.472 | 0.873 | too low | |
| 6. 1st dense layer – relu; 2 dense layers | 1 | 1 | 0.725 | 0.554 |
| 7. 1st dense layer – relu; 2 dense layers; dropout 0.2 after dense | 0.665 | 1 | too low | |
| 8. Learning rate 0.001 | 1 | 1 | 0.716 | 0.504 |
| 9. ‘relu’ for 2 dense layers and ‘softmax’ for the last dense | predicted all samples positive – stopped testing | | | |
| 10. Re-train the last VGG16 layer | 1 | 1 | 0.834 | 0.510 |
| 11. Re-train the last 2 VGG 16 layers | 1 | 1 | 0.836 | 0.557 |
| 12. Re-train the last 2 VGG 16 layers; dropout 0.1 | 1 | 1 | 0.741 | 0.546 |
| 13. Learning rate 0.01 | 0.879 | 0.799 | 0.756 | 0.484 |
| 14-1. Train the last 2 VGG16 layers; input size 112 | 1 | 1 | 0.676 | 0.368 |
| 14-2. Input size 112 | 1 | 1 | 0.812 | 0.513 |
| 14-3. Input size 56 | 0.939 | 0.979 | 0.756 | 0.579 |
| 14-4. Train the last 2 VGG16 layers; input size 56 | 1 | 1 | 0.737 | 0.550 |
| 15. Fully connected layer = Last layer / 2.25 | 1 | 1 | 0.735 | 0.510 |
| 16. Train the last 2 VGG16 layers; 2 dense layers; input size 224 | Unable to train due to a lack of resource | | | |
| 17. Train the last VGG16 layer; 2 dense layers; input size 224 | 1 | 1 | 0.782 | 0.506 |

When the recall rate increases, the precision rate decreases.

The low recall does not serve the purpose of improving the efficiency of the ID verification process, and the low precision does not serve the purpose of security (which is the original purpose of the process). Therefore, I used the original model that was not fine-tuned for a prototype.

The threshold of the prediction was 0.5 during training, testing, and validation. I changed it to 0.75 after running the prototype a few times.