RUTGERS
WINLAB | Wireless Information Network Laboratory

Real-Time Machine Learning

Nelusha Dias
David Banyamin

Summary

- Worked with algorithms and a Convolutional Neural Network to run a facial recognition program on NVIDIA Jetson Nano to identify known, unknown, and masked individuals

- Facial Recognition Program
  - Able to tell who is in the frame
  - If unknown save for later identification
  - Trained to recognize masks and person under it

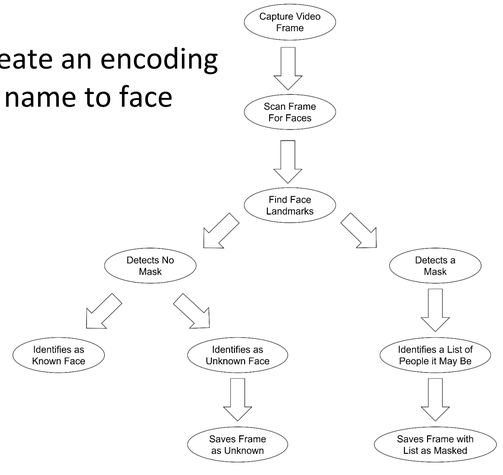
- Potential Use
  - ID people
  - Building Security System
  - Checking for masks

Facial Recognition

- Scan every frame for faces
- Find face landmarks on the detected face and create an encoding
- Iterate through the saved known faces to match name to face

- If person is unknown:
  - Save image of person & count number of visits

- If a mask is detected:
  - Saves the image with a list of possible people



Mask Recognition

- Used a Convolutional Neural Network (CNN) as a model to identify whether a person is masked or not
  - Returns True if masked, False if not

- If the code returns True
  - Real-time video display shows a list of top 10 people that the individual may be
  - Video frame is captured and saved into a file

- If the code returns False
  - Run through the regular facial recognition

```
root@node21-32:~/project# python3 cnn.py
Epoch [1/4], Step [2000/23223], Loss: 0.0003
Epoch [1/4], Step [4000/23223], Loss: 0.0003
Epoch [1/4], Step [6000/23223], Loss: 0.0000
Epoch [1/4], Step [8000/23223], Loss: 0.0002
Epoch [1/4], Step [10000/23223], Loss: 0.0032
Epoch [1/4], Step [12000/23223], Loss: 0.0012
Epoch [1/4], Step [14000/23223], Loss: 0.0000
Epoch [1/4], Step [16000/23223], Loss: 0.0914
Epoch [1/4], Step [18000/23223], Loss: 0.0001
Epoch [1/4], Step [20000/23223], Loss: 0.0002
Epoch [1/4], Step [22000/23223], Loss: 0.0001
Epoch [2/4], Step [2000/23223], Loss: 0.0000
Epoch [2/4], Step [4000/23223], Loss: 0.0006
Epoch [2/4], Step [6000/23223], Loss: 0.0002
Epoch [2/4], Step [8000/23223], Loss: 0.0007
Epoch [2/4], Step [10000/23223], Loss: 0.0033
Epoch [2/4], Step [12000/23223], Loss: 0.0001
Epoch [2/4], Step [14000/23223], Loss: 0.0021
Epoch [2/4], Step [16000/23223], Loss: 0.0000
Epoch [2/4], Step [18000/23223], Loss: 0.0000
Epoch [2/4], Step [20000/23223], Loss: 0.0012
Epoch [2/4], Step [22000/23223], Loss: 0.0000
Epoch [3/4], Step [2000/23223], Loss: 0.0001
Epoch [3/4], Step [4000/23223], Loss: 0.0000
Epoch [3/4], Step [6000/23223], Loss: 0.0002
Epoch [3/4], Step [8000/23223], Loss: 0.0011
Epoch [3/4], Step [10000/23223], Loss: 0.0016
Epoch [3/4], Step [12000/23223], Loss: 0.0015
Epoch [3/4], Step [14000/23223], Loss: 0.0004
Epoch [3/4], Step [16000/23223], Loss: 0.0003
Epoch [3/4], Step [18000/23223], Loss: 0.0001
Epoch [3/4], Step [20000/23223], Loss: 0.0004
Epoch [3/4], Step [22000/23223], Loss: 0.0002
Epoch [4/4], Step [2000/23223], Loss: 0.0000
Epoch [4/4], Step [4000/23223], Loss: 0.0002
Epoch [4/4], Step [6000/23223], Loss: 0.0012
Epoch [4/4], Step [8000/23223], Loss: 0.0002
Epoch [4/4], Step [10000/23223], Loss: 0.0002
Epoch [4/4], Step [12000/23223], Loss: 0.0002
Epoch [4/4], Step [14000/23223], Loss: 0.0000
Epoch [4/4], Step [16000/23223], Loss: 0.0002
Epoch [4/4], Step [18000/23223], Loss: 0.0010
Epoch [4/4], Step [20000/23223], Loss: 0.0007
Epoch [4/4], Step [22000/23223], Loss: 0.0000
Finished Training
```

Future Work

- Improvement on the Convolutional Neural Network for higher accuracy
  - Adjust numerical parameters
  - Add and remove layers
  - Change the loss function

- Adjust ability to read a masked face as a face
  - If there is a larger mask (not tight fitting) the code currently does not identify it as a face

- Ability to read multiple masked faces
  - The program is only able to recognize and register one out of all the people in the frame when someone is wearing a mask

References

Geitgey, A. (2020, October 5). Build a face recognition system for $60 with the new Nvidia Jetson Nano 2GB and Python. Medium. https://medium.com/@ageitgey/build-a-face-recognition-system-for-60-with-the-new-nvidia-jetson-nano-2gb-and-python-46edbddd7264

Face-recognition. (2020, February 20). PyPI. https://pypi.org/project/face-recognition/

Cabani/maskedface-net: Maskedface-net is a dataset of human faces with a correctly and incorrectly worn mask based on the dataset flickr-faces-HQ (FFHQ). (2021, April 28). GitHub. https://github.com/cabani/MaskedFace-Net

Pahinkar, A. (2020, August 25). Implementing CNN in PyTorch with custom dataset and transfer learning. Medium. https://medium.com/analytics-vidhya/implementing-cnn-in-pytorch-with-custom-dataset-and-transfer-learning-1864daac14cc

Training a classifier — PyTorch tutorials 1.9.0+cu102 documentation. (2021). PyTorch. https://pytorch.org/tutorials/beginner/blitz/cifar10_tutorial.html

WINLAB