Project 3 Report

List of assumptions

The setup and test of the project requires a dark environment/room, and a dark background for presenting cards to the camera.

- Image acquisition using laptop onboard rear camera (Surface laptop, 1080P).
- Distance between computer camera and card bench is about 10 inches.
- A flash light with the lowest brightness shine on the card bench 9 feet away. (Only light source) The elevation of the flash light is 10 inches higher than card bench, and is shined horizontality.

Algorithm pipeline

- Flowchart on second page.

Subset of results

- Tested all 13 ranks and 4 suits in order from Ace to King, and mixed ranks and suits.
- All tests past.
    - If the light source is excessive, the cards would reflect enough light to distort the captured image and produce wrong results.
- Convolutional Neural Network used to train ranks and suits were both at 99.5% accuracies.

Brief description of contribution of each group member

Sorokin Aleksei:

- Data collection of ranks and suits.
- Training of the Convolutional Neural Network, and classification.

Leya Zeng:

- Image acquisition, processing, and display output.
- Project report, demo video.

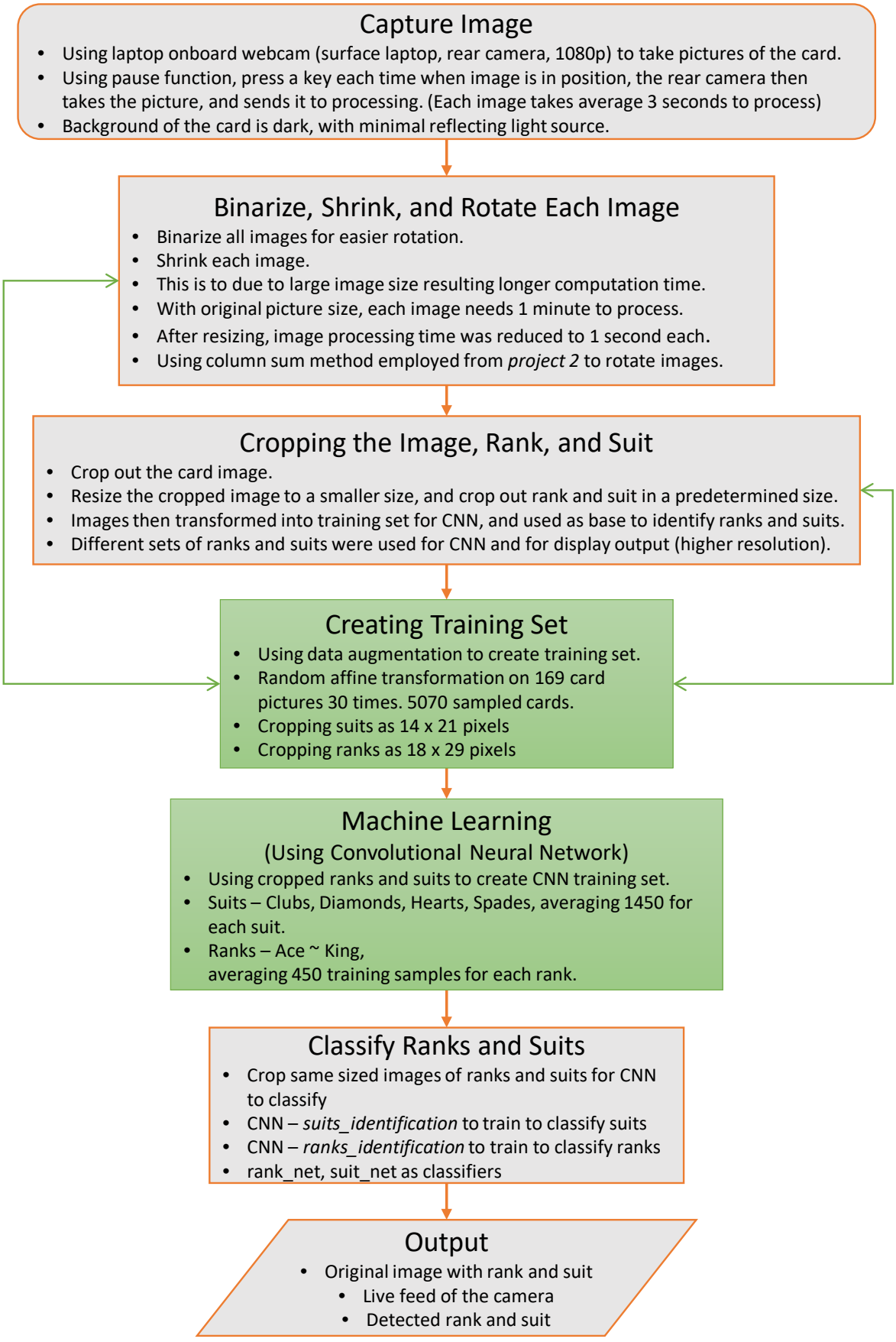
List of references

- CNN: https://www.youtube.com/watch?v=4wmCg4Smpj0
- MATLAB help documentation.

Demonstration video

- YouTube: https://youtu.be/oGUhvhhheXE

Flowchart


Capture Image
• Using laptop onboard webcam (surface laptop, rear camera, 1080p) to take pictures of the card.
• Using pause function, press a key each time when image is in position, the rear camera then takes the picture, and sends it to processing. (Each image takes average 3 seconds to process)
• Background of the card is dark, with minimal reflecting light source.
Binarize, Shrink, and Rotate Each Image
• Binarize all images for easier rotation.
• Shrink each image.
• This is to due to large image size resulting longer computation time.
• With original picture size, each image needs 1 minute to process.
• After resizing, image processing time was reduced to 1 second each.
• Using column sum method employed from project 2 to rotate images.
Cropping the Image, Rank, and Suit
• Crop out the card image.
• Resize the cropped image to a smaller size, and crop out rank and suit in a predetermined size.
• Images then transformed into training set for CNN, and used as base to identify ranks and suits.
• Different sets of ranks and suits were used for CNN and for display output (higher resolution).
Creating Training Set
• Using data augmentation to create training set.
• Random affine transformation on 169 card pictures 30 times. 5070 sampled cards.
• Cropping suits as 14 x 21 pixels
• Cropping ranks as 18 x 29 pixels
Machine Learning
(Using Convolutional Neural Network)
• Using cropped ranks and suits to create CNN training set.
• Suits – Clubs, Diamonds, Hearts, Spades, averaging 1450 for each suit.
• Ranks – Ace ~ King,
averaging 450 training samples for each rank.
Classify Ranks and Suits
• Crop same sized images of ranks and suits for CNN to classify
• CNN – suits_identification to train to classify suits
• CNN – ranks_identification to train to classify ranks
• rank_net, suit_net as classifiers
Output
• Original image with rank and suit
• Live feed of the camera
• Detected rank and suit