A semi-supervised method for infrared-reflectance (IR) image quality assessment

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PURPOSE

- Determination of IR image quality is paramount to effectiveness of eye motion tracking algorithms which enables reduced motion in optical coherence tomography (OCT) image acquisition.
- In this project we create a data driven approach for IR image quality classification with minimal manual labeling effort for real time use

METHODS

- We collected 9659 IR images from 8 subjects for 9 different fixations including central and peripheral fixations and generated a dataset of:
  1. Acceptable quality (AQ)
  2. Unacceptable quality (UQ)
  3. We used our reference image-based IR tracking algorithm [1] to generate the training data. Tracking relies on generating landmark points in two images and comparing them. Success / failure at this task was used to create rules for classifying AQ & UQ images
- The tracking output landmark number & distribution were used as a measure of IR moving image quality to generate initial training set divided into AQ & UQ classes.
- A grader reviewed the initial training set to correct misclassifications in the training set (Fig1). Because only corrections to an initial classification were required, this could be done quickly.
- Inputs to the neural network were 3 adjacent temporal frames of the IR images; a VGG style network was trained on this dataset to predict the quality of given image
- After an initial round of training the network was run on a large UQ image dataset created using the pipeline. The 100 highest confidence incorrect images are included in the train set and the network was retrained using these hard negative images.

A semi-supervised workflow may be used to assess IR quality more efficiently

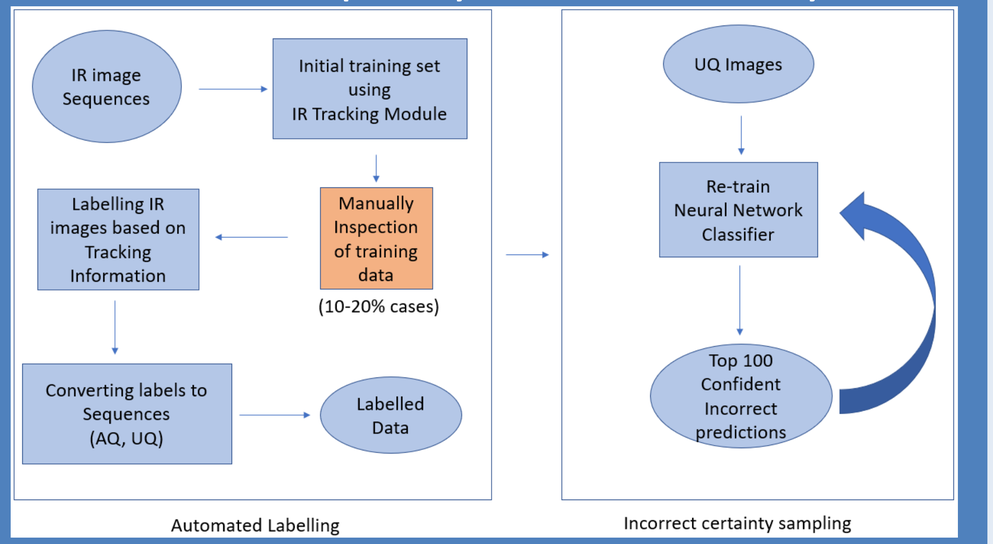

Figure 1: Visual Depiction of the IR quality training workflow

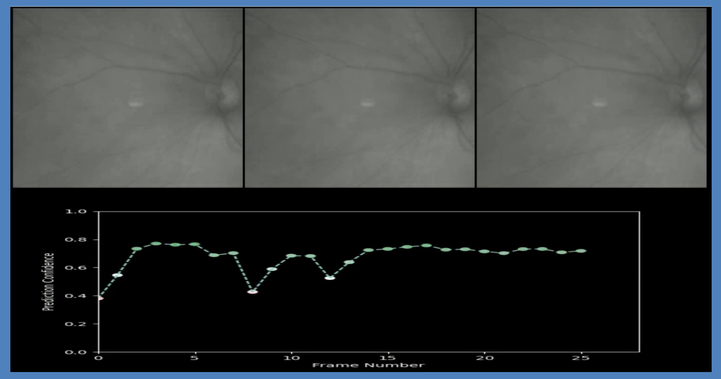

Figure 2: Example outputs for a set of sequences

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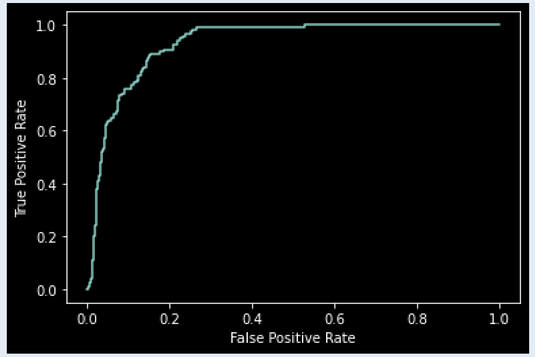

Figure 3: ROC curve for the IR quality model

RESULTS

- The resulting performance was measured by visualizing the images as a video sequence along with the continuous confidence prediction curve (Figure 2).
- The network has an area under the curve (AUC) of 0.905 (Figure 3) on the hold out test set of 3,332 images (of which 2,402 images are hard negatives).
- The runtime of the IR quality model is 40 ms on an Intel CoreTM i7-9870H CPU.

CONCLUSIONS

- The initial results of the proposed training method indicate that real time image quality assessment for IR image
  - Has reasonable runtime performance
  - Can work with a limited number of available datasets
- Hence it enables usage in a real-world setting to reduce labelling effort.

References

[1] Bagherinia et al. IOVS 2020; 61(9): Abstract PB0060.