**Iowa Initiative for Artificial Intelligence**

**Final Report**

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| Project title: | Use of machine learning in the detection of eyelid malignancy using clinical photographs |
| Principal Investigator: | Chau Pham MD, Keith Carter MD, Erin Shiver MD, Brittany Simmons MD, Nasreen Syed MD, Douglas Critser CRA |
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| Other investigators: | |
| Date: | |

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| Were specific aims fulfilled: | Y |
| Readiness for extramural proposal? | Yes – Additional laterality-specific expert labeling needed |
| If yes … Planned submission date | |
| Funding agency | |
| Grant mechanism | |
| If no … Why not? What went wrong? | Ground truth about malignancy status is needed for each eye separately to improve the diagnostic accuracy. |

**Brief summary of accomplished results:**

We developed and validated a VGG-16 model to automatically classify eye malignancy with achieved classification correctness of 0.72 in training and 0.59 in validation.

**Research report:**

**Aims (provided by PI):**

To use a machine learning algorithm to identify and classify cutaneous eyelid lesions based on external clinical photographs.

**Data:**

Clinical photographs of full faces of patients and pathologic "truth" were collected for 1339 patients.

**AI/ML Approach:**

In this study, a VGG-16 model was implemented for eye malignancy classification – each two-eye (left-right combined) image was classified as malignant or benign. Training/validation split was 80%/20%.

**Experimental methods, validation approach:**

Data Preparation

Data preparation or pre-processing is an essential step in any machine learning study. In order to focus on eye area, we identified and then cropped each of the two eye areas (left eye, right eye)

for each patient and resized it to the size of 234x234. After preprocessing, we got 1104 images (315 malignant/ 789 benign).

Figure 1. cropped areas of different groups (1st row: benign; 2nd row: malignant) – Removed for Web posting.

Image classification

The VGG-16 is one of the most popular pre-trained models for image classification; its architecture is shown in Fig. 2.

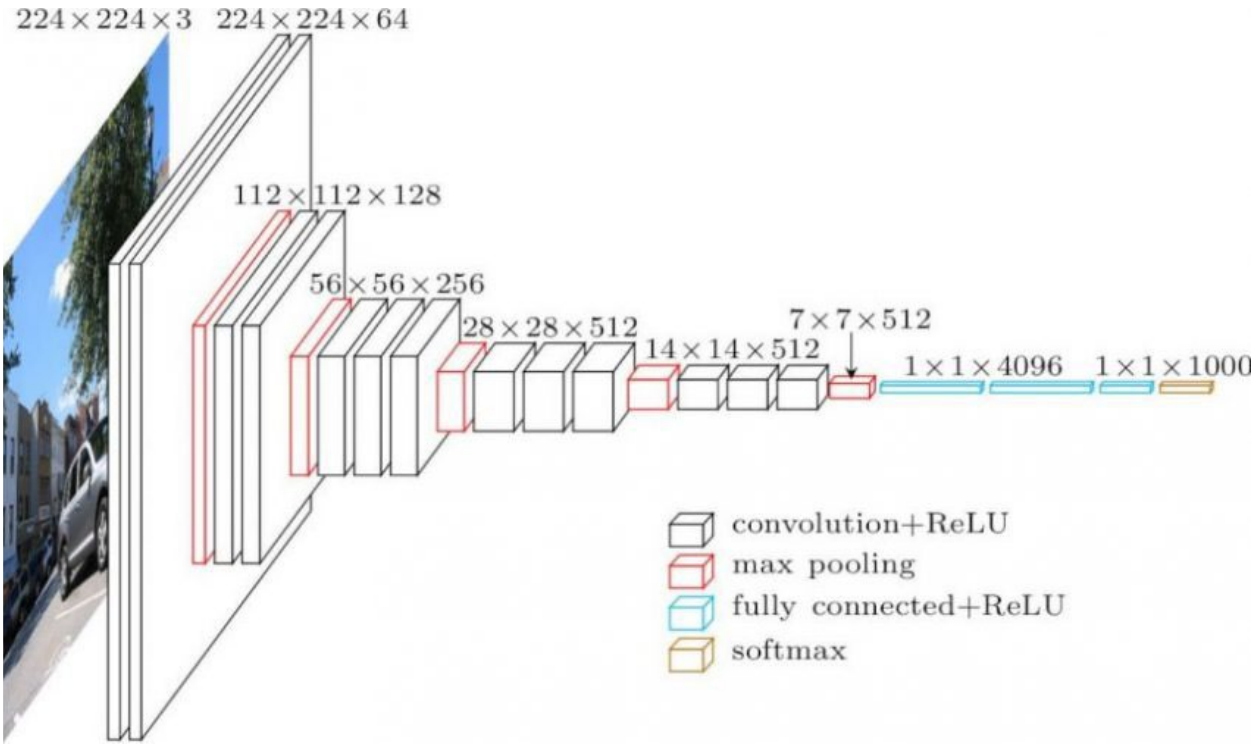


Figure 2. VGG16 architecture [1]

**Results:**

The original data is unbalanced dataset. We created a balanced dataset by upsample: 1034 images (554 malignant/480 benign) for training and 156 (77 malignant/79 benign) images were used for validation. The accuracy of VGG-16 model to automatically classify eye malignancy was 0.59 in the validation group and F1-score was 0.61. The confusion matrix is [tn, fp, fn, tp]=[37,42,25,52].

In future study, ground truth (malignancy) of each eye, lesion location and patients' clinical information are needed to improve clarification accuracy.

Figure 3. Examples of eye malignancies classification. 1st row: all malignant and all correctly labeled; 2nd row: all benign and all correctly labeled; 3rd row: all malignant and incorrectly labeled; 4th row: all benign and incorrectly labeled. Removed for Web posting.

**Publications resulting from project:**

None