

# Vision Guided Mosquito Dissection for the Production of Malaria Vaccine

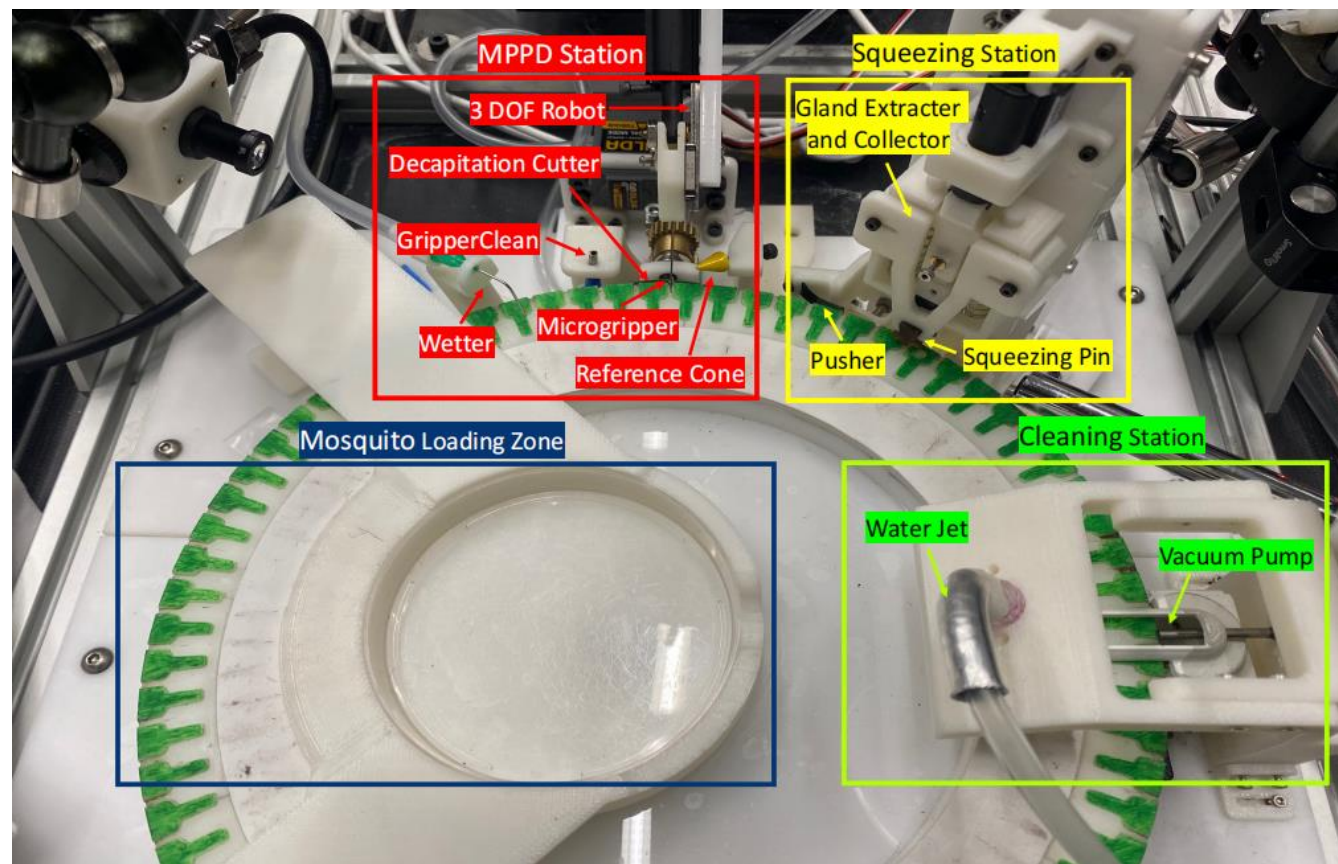
Computer Integrated Surgery II  
Spring, 2023

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## Introduction

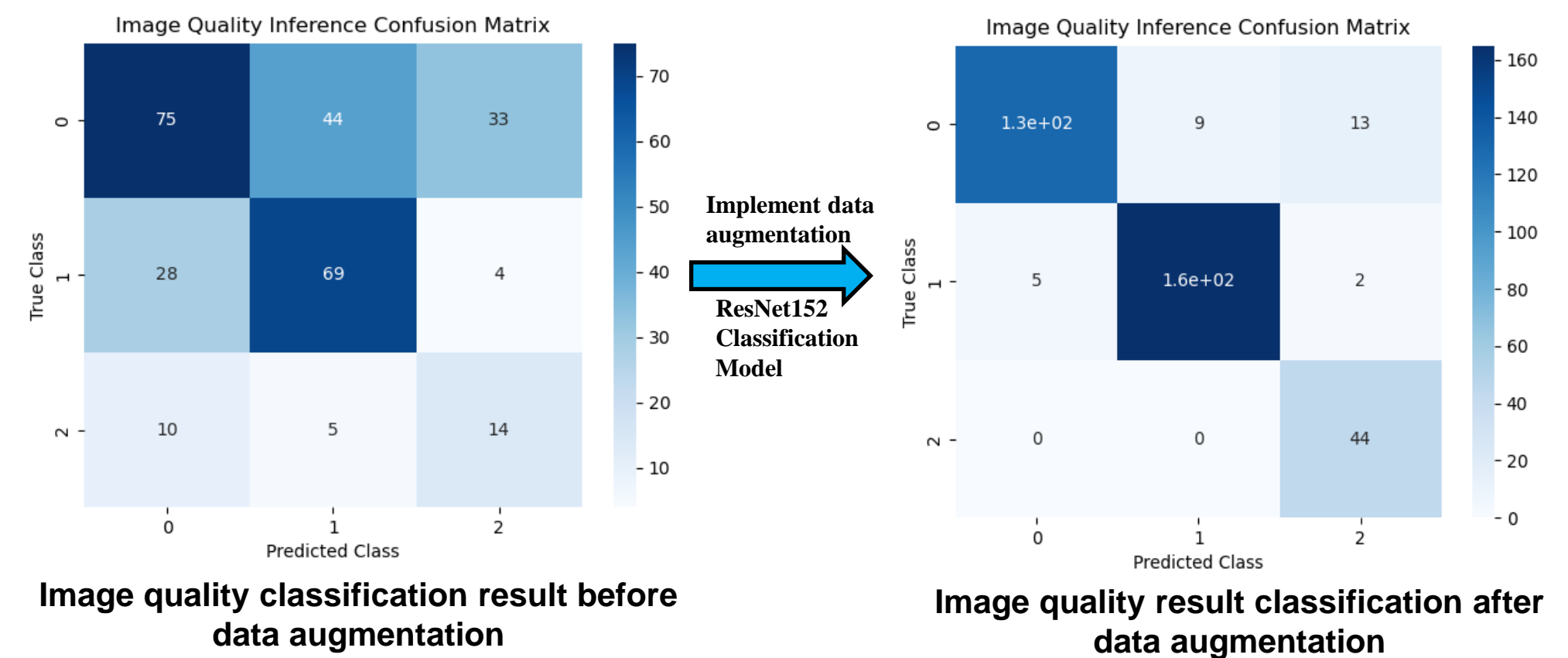
The development of an effective malaria vaccine has become an urgent priority. One promising candidate is the Plasmodium falciparum sporozoite vaccine developed by Sanaria, Inc.. The autonomy of the robotic dissection system hinges on computer vision methods. Project's task is implementing classification neural networks to complete:

- Mosquito Orientation Detection
- Exudate Quality Evaluation
- Prediction of Dissection Success



Automated dissection system overview

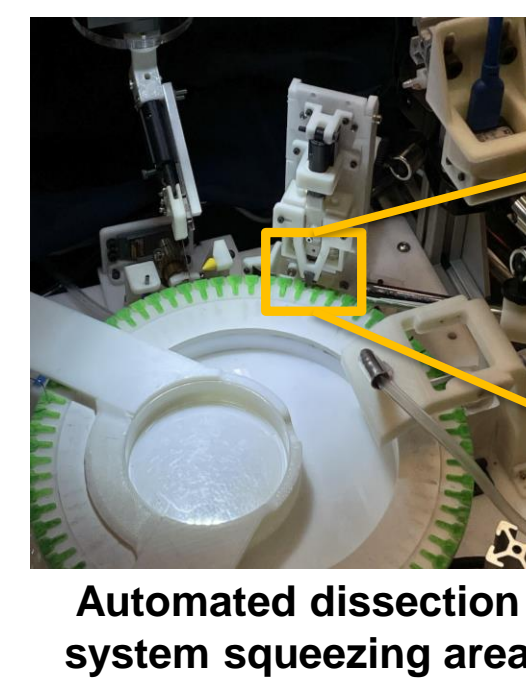
Image quality classifier inference results shown in confusion matrix:



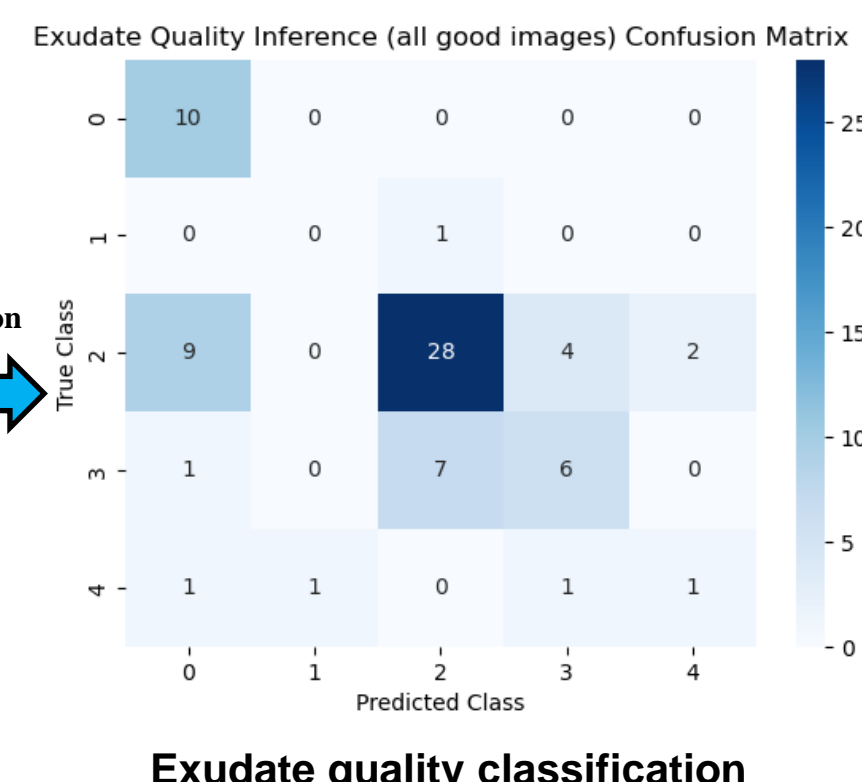
A large number on the diagonal of the confusion matrix indicates that the classifier is performing well. It means the predicted class matches the true class.

## 2) Exudate quality classification

Class Number	Exudate Quality
0	No exudate
1	Low volume exudate
2	Exudate quality 1
3	Exudate quality 2
4	Exudate quality 3



Exudate front and side view images

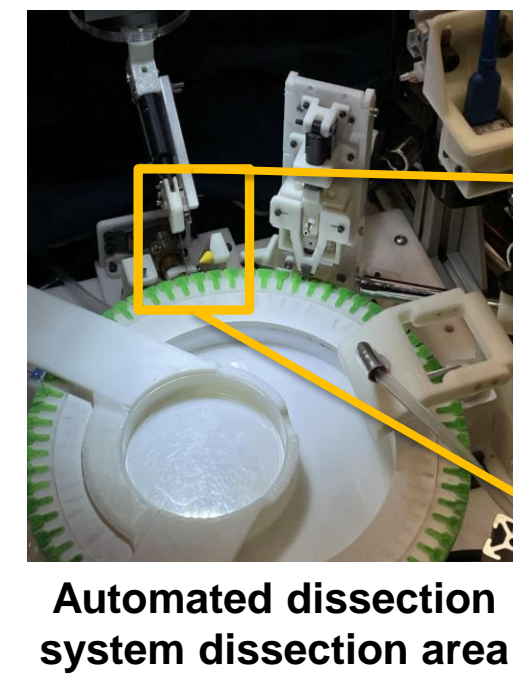


Exudate quality classification

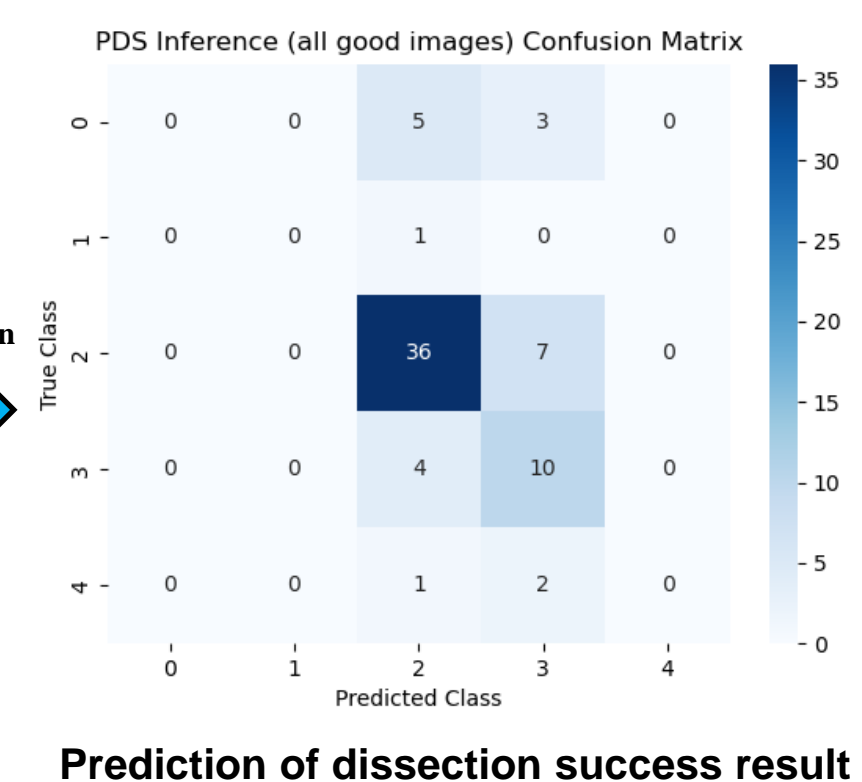
The classifier performs well. For class 1,3 and 4, there is limited amount of such data in the dataset. If more exudate image data are collected and the model is retrained, this exudate quality classifier will perform better.

## • Prediction of Dissection Success

Class Number	Exudate Quality
0	No exudate
1	Low volume exudate
2	Exudate quality 1
3	Exudate quality 2
4	Exudate quality 3



Placement overhead and side view images



Prediction of dissection success result

The numbers in the confusion matrix are concentrated along the diagonal in the confusion matrix rather than randomly distributed. This shows that we can predict the exudate quality given the placement of mosquitoes in the early stage.

## Future Work

- Based on the Prediction of Dissection Success results, investigate methods to locate specific regions on mosquito images that contribute strongest to variability in exudate quality.
- Develop exudate volume estimation.

## Lessons Learned

- Give professionals the data they need to label early.
- Documentation for codes is important.
- Expect the unexpected.

## Credits

- Yutai Wang: Responsible for all tasks.

## Publications

- "Applications of Uncalibrated Image Based Visual Servoing in Micro- and Macroscale Robotics", 2023 IEEE CASE (Submitted)

## Support by

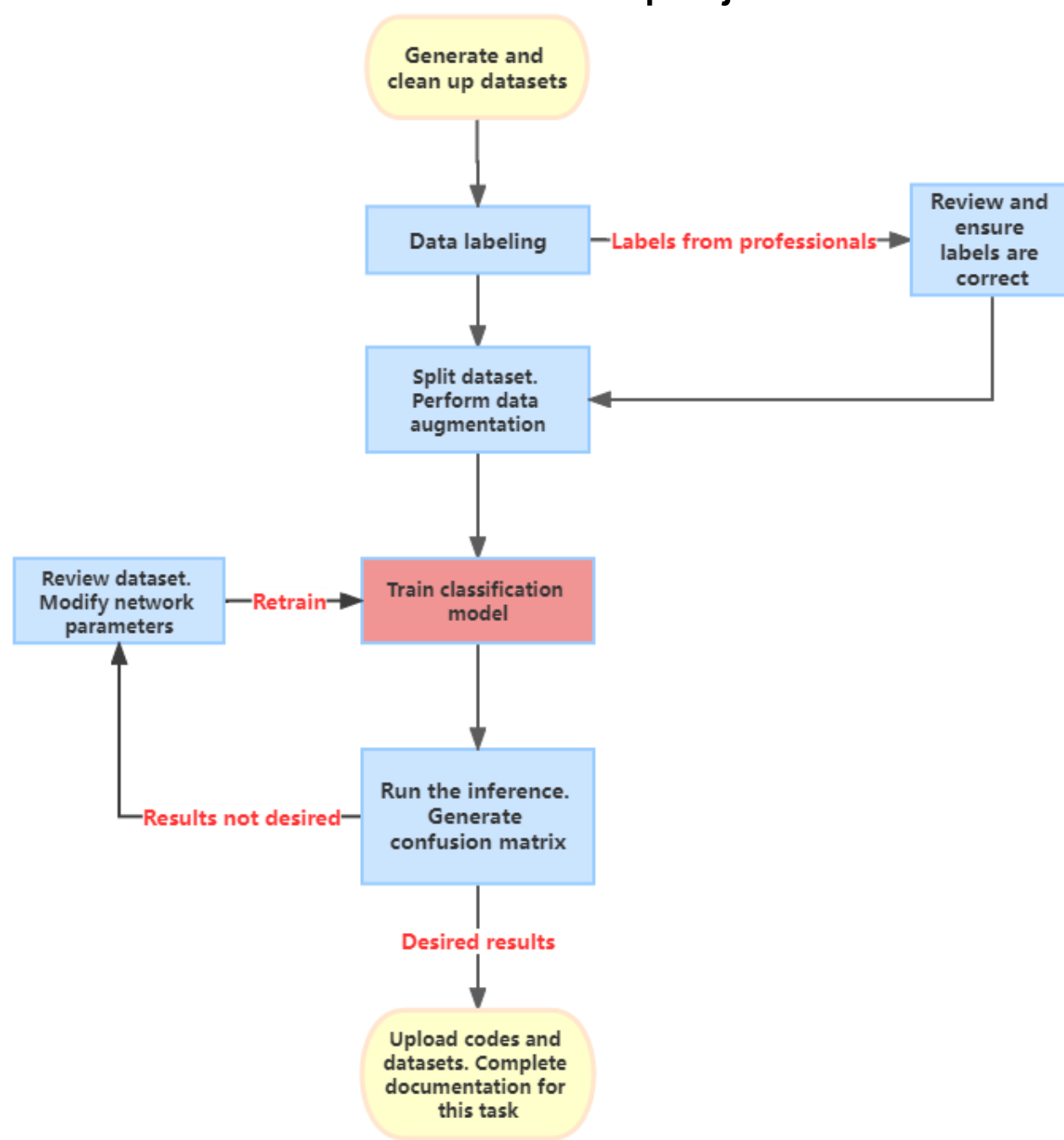
- This work was supported in part by NIH grant 2R44AI134500-04A1 in collaboration with Sanaria, Inc. Rockville, MD, USA and in part by Johns Hopkins University internal funds.
- Thanks to my mentor Balazs Vagvolgyi.

## The Problem

- The images in database is not properly labeled.
- No classification neural network for these tasks available in the project's Gitlab.
- Incomplete documentation in the project's Gitlab.
- Implement these tasks can better support the work of the robotic dissection system.

## The Methods and Results

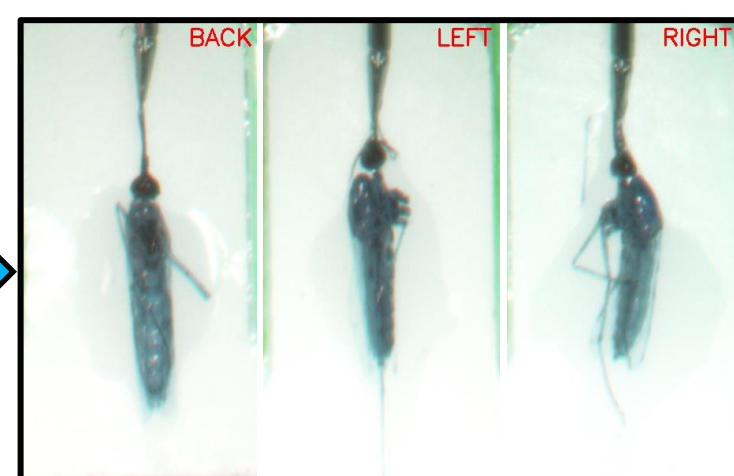
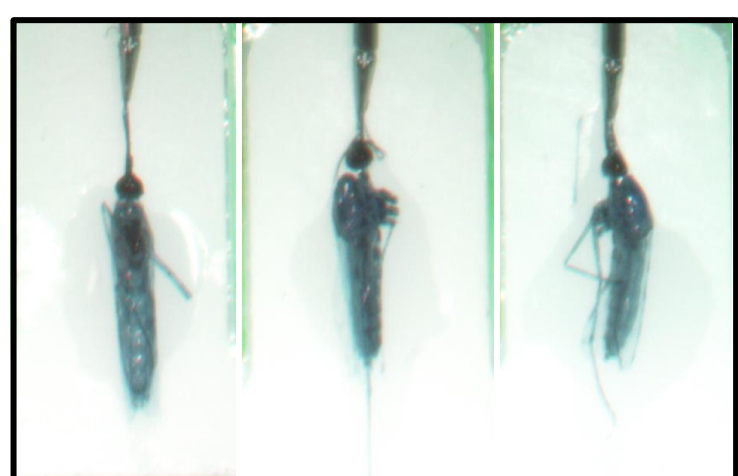
Generate and clean up dataset for each task. Develop codes for classification neural networks. Train classification models (VGG16, DenseNet121, Resnet18/152), and run the inference on the validation dataset. The flow chart for this project:



Project classification training flow chart

## • Mosquito Orientation Detection

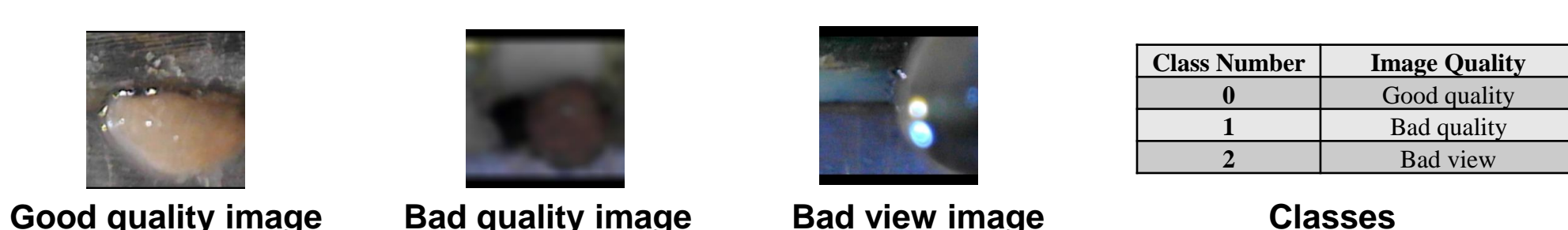
Class Number	Mosquito Orientation
0	No mosquito
1	Left
2	Right
3	Back
4	Belly
5	Other



Mosquito orientation classification results

## • Exudate Quality Evaluation

1) Image quality classification  
Template input images and classes:



Good quality image

Bad quality image

Bad view image

Classes

