



Department Project Information

Department Name	<i>Electrical and Computer Engineering</i>	Date Submitted	<i>10/26/2022</i>
Project Title	<i>OphthoTool: A retinal imaging biomarker platform for retinal disease classification (UNCC_ECE_OPTHO)</i>	Planned Starting Semester	<i>Fall 2023</i>

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical		Electrical	2
Computer	2	Systems	
Other ()			

Project Overview:

This project aims to establish quantitative imaging features in the retina for automated classification of diabetic retinopathy (DR). Successful implementation of this project will standardize imaging features from optical coherence tomography (OCT) and OCT Angiography (OCTA) retinal imaging devices for objective detection, prediction and assessment of DR treatment outcomes. We will develop and validate a software package (OphthoTool) with a graphical user interface that will have the option to process format agnostic retinal images from healthcare institutes and provide imaging biomarkers with disease prediction probabilities.

As a leading cause of preventable blindness, DR affects 40-45% of diabetic patients. An estimated 425 million adults have diabetes worldwide, corresponding to 12% (\$727 billion) of global health expenditures. Early detection, prompt intervention, and reliable assessment of treatment outcomes are essential to prevent irreversible visual loss from DR. Retinal vascular abnormalities, such as microaneurysms, hard exudates, retinal edema, venous beading, intraretinal microvascular anomalies and retinal hemorrhages are common DR findings. The use of OCT/OCTA to provide depth-resolved imaging capability to differentiate individual capillary plexuses has been applied to DR and other retinovascular diseases. However, the clinical utility is not yet fully determined. Quantitative feature analysis of DR holds promise, since translating subjective findings into objective assessments will standardize retinal imaging features, which is essential prior to its use in assessing treatment outcome. In addition, objective OCT/OCTA analysis through the use of a packaged executable software may provide potential telemedicine applications in rural and underserved areas where the



access to experienced ophthalmologists is limited.

The overall project will be divided into three main tasks:

Task1: Conceptual design - At first the students will investigate all the retinal imaging features and organize them for OphthoTool backend. They will make critical decision to include/exclude significant features based on correlation analysis. They will also conceptually design the OphthoTool software and its functionalities.

Task2: OphthoTool development – The OphthoTool software will be an executable software preferably built on JAVA with a Python backend. The students will develop this software based on the conceptual design in task 1.

Task3: Validation – Students will validate their software on data coming from three different institutions (Stanford, Wake Forest, and Illinois Eye and Ear). They will train the collaborators at these institutions to use the OphthoTool software and generate feedback on the usage and performance of the software.

For computational tasks (Tasks 1 and 2), the students will have access to LAMBDA GPU servers and workstations in Dr. Minhaj Alam’s laboratory.

Expected Deliverables/Results:

- An executable OphthoTool software which can output retinal imaging biomarkers and DR prediction using OCT and OCTA imaging modalities.
- Robust validation performance for the prediction tools (>85% accuracy).

Disposition of Deliverables at the End of the Project:

The software and codebase developed in this project will be the property of the mentor and the department.

List here any specific skills, requirements, specific courses, club affiliation, knowledge needed or suggested (If none please state none):

- Familiarity or interest in image processing and machine learning.
- Experience in coding in Python, JAVA or C++.
- Interest in medical AI applications.
- At least one member of the team should enroll in the ECGR4090 course “AI for biomedical applications ”