# Computer Science GTA Project

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**Section 2 – *Project Information***

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| **Project Title** | AI-driven Photometric Stereo for 3D Fundus Reconstruction: A Non-Invasive Alternative to OCT | |
| **Project Highlights:** | 1. | Proposes a low-cost, AI-based photometric stereo 3D fundus reconstruction from 2D fundus images, supplementing the limitations of OCT. |
| 2. | Addresses key challenges in fundus including uncalibrated lighting, semi-transparent tissues, and one-shot photometric stereo. |
| 3. | Provides interdisciplinary PhD training in deep learning, computational imaging, and vision-based healthcare. |
| **Project Summary** | | |
| Fundus diseases are a major cause of blindness worldwide, and timely, quantitative diagnosis is critical. Optical Coherence Tomography (OCT) is currently the gold standard due to its ability to provide precise 3D structural information of the fundus. However, OCT suffers from several practical limitations: (1) it requires time-consuming line-by-line scanning, making it unsuitable for uncooperative patients such as infants or those with neurological disorders, often requiring pupil dilation or anesthesia; (2) it covers only a narrow field of view, typically focused on the optic disc region; and (3) it is costly and inaccessible in resource-limited settings.  This project proposes an AI-driven photometric stereo (PS) solution to reconstruct quantitative 3D fundus surfaces using only 2D images from slit lamps or fundus cameras. By leveraging deep learning-based PS techniques adapted to the retinal domain, the project seeks to provide a non-invasive, low-cost alternative that can complement or substitute OCT in certain clinical scenarios.  The work faces unique domain-specific challenges, such as uncalibrated natural illumination, semi-transparent fundus media causing interreflections, and detailed surface features like blood vessels and folds. It will also explore one-shot PS strategies to enable reconstruction from minimal input frames. The ultimate goal is to enhance diagnostic capabilities using widely available imaging tools, thereby improving accessibility and affordability of retinal healthcare. | | |