A low-cost and portable retina camera with AI image enhancement to expand access to ophthalmologic care.

**PROBLEM**
Over 370 million people in the world suffer from an eye disease, most commonly diabetic retinopathy, macular degeneration, or glaucoma. When detected early, the likelihood of preventing blindness can increase as much as 95%. Each of these eye diseases can be detected and diagnosed with a retinal camera. However, detection and diagnosis currently require a highly trained ophthalmologist and a clinical fundus camera costing over $20,000 on average making ophthalmology highly inaccessible in developing parts of the world. Currently, there exist some low-cost retina cameras, but they still require ophthalmologists to operate or fail to capture high enough quality images for AI automated screening.

**SOLUTION**
A-Eye is a mobile retinal camera designed for users who are not medical professionals. It utilizes unique software and hardware techniques to capture high-quality fundus images at a low cost eliminating the need of ophthalmologists for retinal imaging. The camera is able to achieve at least a 40° view of the retina and utilizes computer vision techniques to enhance the image through stitching different views of the fundus and removing glare. The processed image is able to utilize the screening capability of a classification model trained on high-quality images obtained from a clinical-grade dataset. The processed image is then passed through a Convolutional Neural Network for screening results of diabetic retinopathy.

**SOFTWARE**
- Classify image for Diabetic Retinopathy with a CNN
- Stitch images for larger field of view
- Enhance quality of the image
- Deliver results to patient

**HARDWARE**
- 3-axis translation stage
- Adjustable camera focus
- Flexible eye cup
- Final prototype

**PROCESS**
We approached this problem by first understanding the constraints defined by our stakeholders. Then, we prioritized the features of the camera considering the cost, resources needed, and impact on quality. Using an iterative approach, we conducted usability and functional testing to continuously improve the prototype.

We worked with ophthalmologists and optical engineers to design an optical path to maximize illumination and minimize glare. This was done with a combination of polarizers and a condensing lens. An important step in our prototyping phase was working with an optical bench with which we were able to optimize the lighting and imaging paths.

Since there was a quality difference between the device image and the dataset for CNN, we experimented with a variety of pre-processing techniques. We found that multicolor segmentation obtains reliable screening results.

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