FixEye

Non invasive preventive healthcare

The Problem

Preventive healthcare in low resource areas lack of access to medical facilities with diagnostic equipment, which causes millions of deaths per year.

- Invasive testing is difficult to achieve
- Lack of testing infrastructure
- Inadequate skilled workforce

Global Health Significance

1. Diabetic retinopathy is a medical condition in which damage occurs to the retina due to Diabetes mellitus (high level of blood sugar). This Chronic Disease is also one of the leading causes of blindness in people aged 20 to 64 around the world. Each year in the US, diabetic retinopathy accounts for 12% of all new cases of blindness.

2. A study done by Google can determine if a person has a chance of suffering from a Cardiovascular event in the following 5 years by looking at a retinal images with **72% accuracy**. This accuracy is higher than the commonly used SCORE method of predicting cardiovascular risk, which requires a blood test.

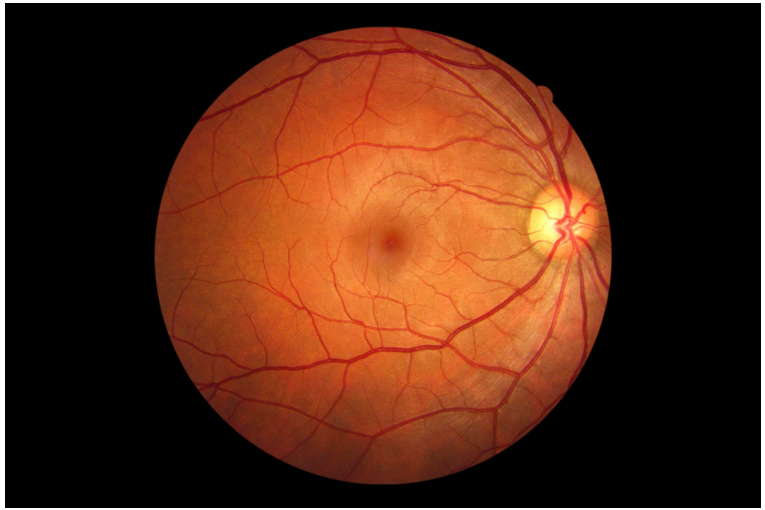
3. Deep Learning AI has the potential to diagnose all kinds of retinal and macular eye diseases.

[1] Sayres, R. and Krause, J. (2018). Improving the Effectiveness of Diabetic Retinopathy Models. [online] Google AI Blog. Available at: https://ai.googleblog.com/2018/12/improving-effectiveness-of-diabetic.html [Accessed 20 Oct. 2019].
[2] Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning. (Google)

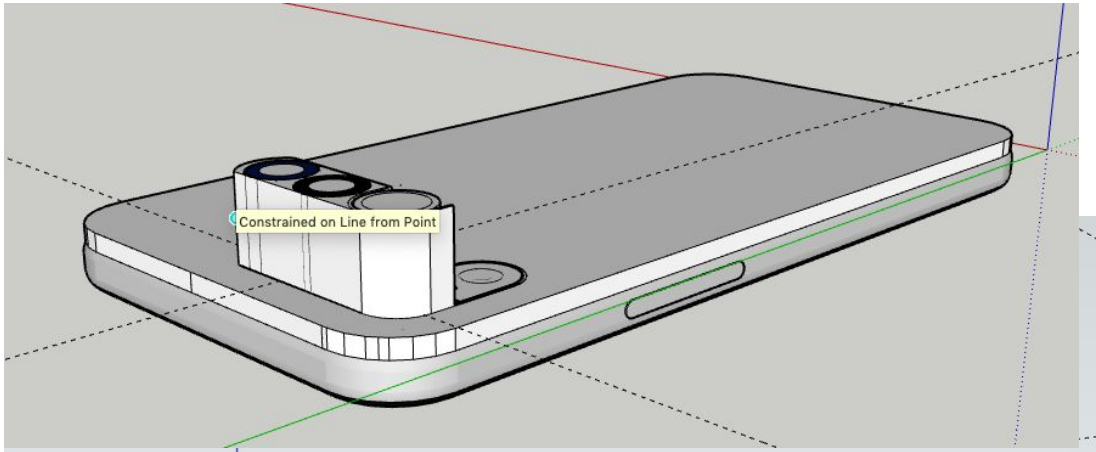
Solution

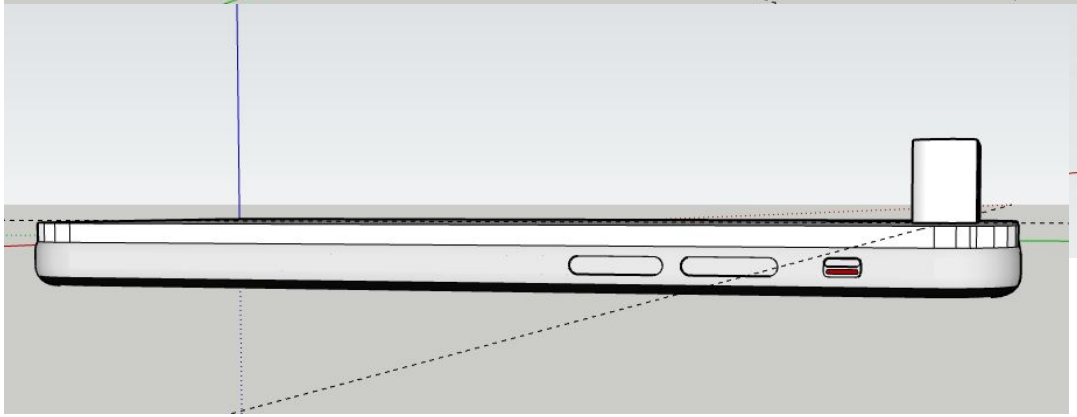
Create a smartphone camera module which captures fundus with a colored camera and an IR sensor, and use machine learning to diagnose the patient.

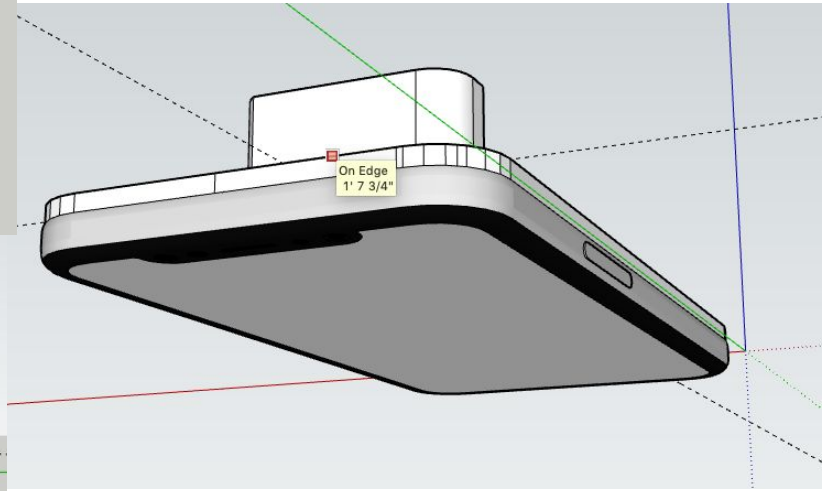
Capture retinal images to predict Diabetic Retinopathy



Proof of Concept

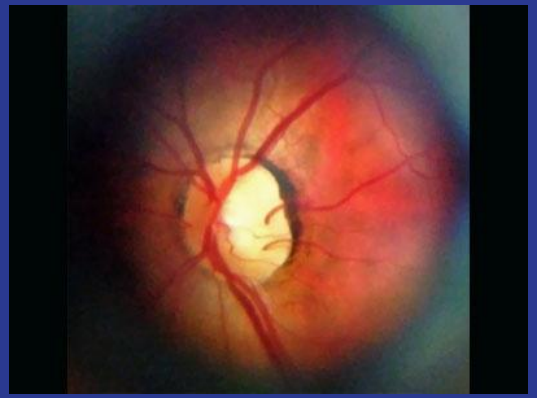






How do we collect images ?

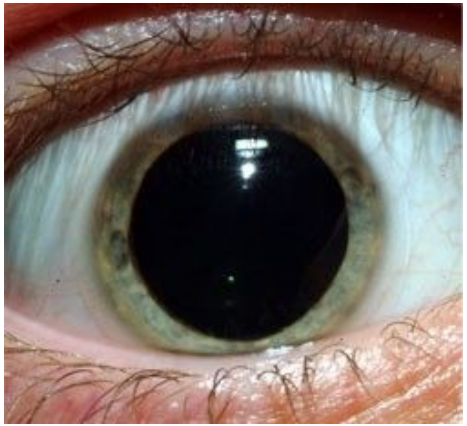
- Low cost
- Accurate
- Smart



Challenges

Image Stability

Skilled Workforce



Dilated Pupil

Optical Physics

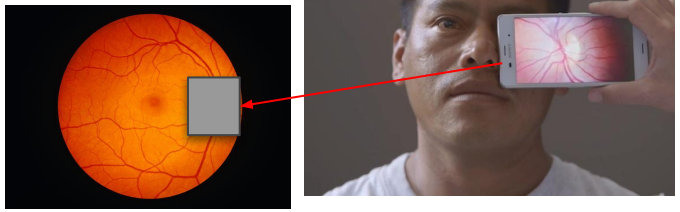
The Challenge

- An unstable Camera
- Limited viewing angle
- Resolution of the image

Design of the case increases the grip and the gives feedback to the user via built in sensors

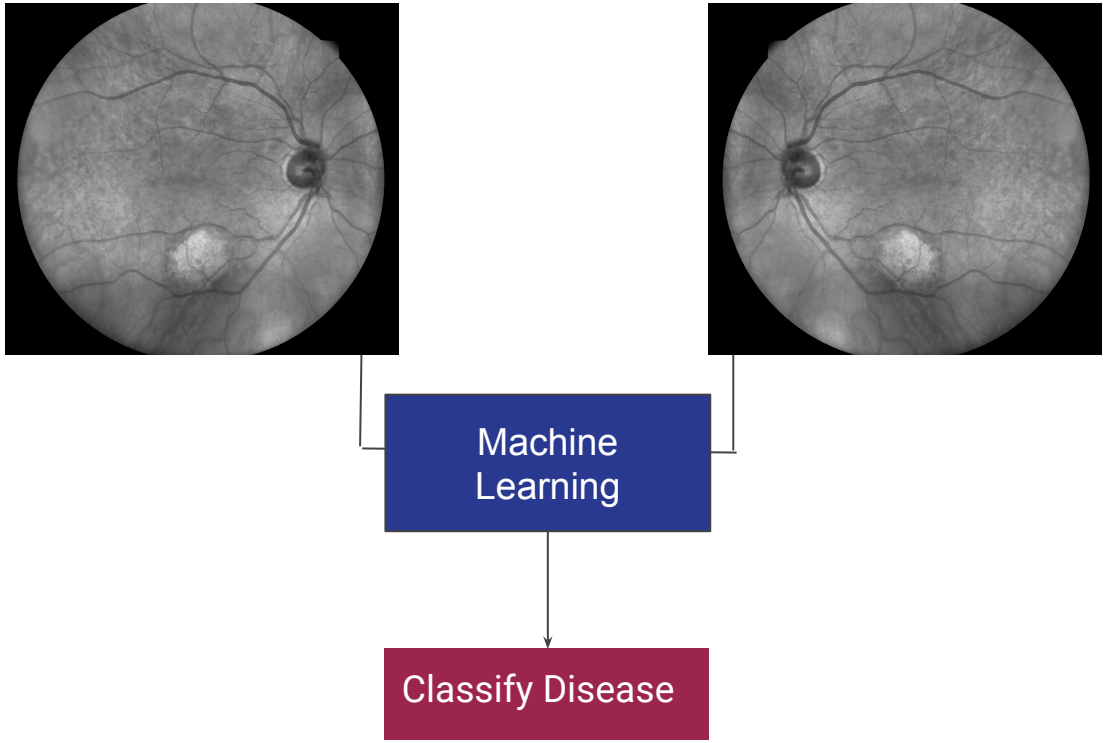
- Accelerometer
- Gyroscope

Stitching Images of the eye as if it is a panoramic picture.



In order to distinguish the difference between various layers of the retina, the corresponding app can use various Machine Learning models while stitching the small parts of the retina image.

Infrared Images



Our Model and Results

We were able to detect diabetic retinopathy with a 78.67% accuracy using just a fraction of the Messidor dataset (U of Iowa, Carver College of Medicine). The accuracy can be improved with more images.

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32/70 [============>.................] - ETA: 0s - loss: 0.7060 - accuracy: 0.5625
64/70 [==========================>...] - ETA: 0s - loss: 0.6166 - accuracy: 0.6875
70/70 [==============================] - 1s 16ms/step - loss: 0.6260 - accuracy: 0.6714
Test set loss:  0.4818101000785828
Test set accuracy:  0.7866566865348816
```

Google was able to achieve a performance that is on-par with that of ophthalmologists. Their algorithm had a F-score (combined sensitivity and specificity metric, with max=1) of 0.95, which is slightly better than the median F-score of the 8 ophthalmologists they consulted (measured at 0.91).