My Project: “EYEternal,” a novel, patent-pending application that allows screen-users to maintain a normal eye blinking rate (15 to 20 times per minute) by analyzing user’s eye blinking frequency with extra features such as vision testing and synchronized eye training.

The Scenario (identified problem): In this world of technology, more than 89 percent of households own a computer or laptop, and more than 97 percent individuals own a smartphones in United States. People frequently facing screens often experience extreme fatigue on their eyes. Although many laptop-users do not notice it, the fatigue on their eyes is caused by a decrease in blinking frequency, evidenced by a research that “looking at digital screens can decreases the eye's blink rate by 66% from an average of 18 blinks a minute, with a higher rate of incomplete blinks which are less functional”. Although it seems very trivial, blinking of eyes plays a huge role in keeping our eyes “healthy by keeping them oxygenated and moist, and clearing out debris”. Therefore, it is evident that keeping our eyes blink in a normal rate,15 to 20 times per minute, even when viewing screen, is crucial in maintaining a healthy eye. Especially in this COVID-19 era, where many students and workers have to look at screens for more than 10 hours a day for distance learning/work, the problem regarding reduced eye-blinking rate can be a serious problem to their eye health.

Initial Consultation with Client: My client Dustin Kim is my younger brother, currently a sophomore at Shanghai American School. He is one of many students who had distance (online) learning due to social-distance policy imposed by government in response to the spread of COVID-19. He recalled this experience as a really tiring period where he has to consistently immerse his eyes into the laptop screen for more than 10 hours a day. Since he wants to be a pilot, he especially cares a lot about his eyesight. He told me about 4 problems with his screen habit:

1. He is usually not aware of how long he has looked at the screen, but he wants the screen-break time before his eye gets too tired
2. Since blinking is a reflex, he cannot control how frequently he blinks his eyes
3. Although he tries to spare some time to exercise his eyes, he usually forget about it
4. It is inefficient and tiring to regularly go to ophthalmology hospital to check his eyesight, so he does not know if his eyesight actually gets worse or not

The Proposed Product: After consulting with him, I proposed a novel synchronized laptop/computer-based application that uses screen camera to continuously analyzes eye blinking and gives automatic, instantaneous reactions such as

1. turning screen brightness to zero for a second, which allows user to automatically blink his/her eye,
2. showing a cursor for user to follow, which allows user to exercise his/her eye,
3. and regularly (user can set this duration) suggesting a screen-break along with advice on helpful eye exercise to do during the break.

This application will also provide an eyesight test, which will ask users to regularly (once a month) to test user’s eyesight. With the data collected from these tests and user’s blinking rates, the application will provide monthly analysis (similar Screen Time on iPhone/Mac) on user’s eye health along with an advice such as foods to eat and exercises to do.

Rational: By giving these instantaneous and regular advices and reactions, users will be able to maintain healthy blinking rates and pay much more attention on his/her eye health. In short, users will be able to maintain healthy eye.

Software to Use: Python, OpenCV
Since my application will involve a lot of numerical manipulations to analyze the data from vision testing and blinking detection, Python will be useful as Python is strong for mathematical computations. Also, since my application will require a machine learning that automatically detects user’s eye blinking pattern, and Python provides a lot of machine-learning libraries, Python would be helpful. In particular, Python supports OpenCV - library of programming functions mainly aimed at real-time computer vision. Since my application will utilize computer/laptop camera to detect blinking of eyes, OpenCV will be used. Python is also compatible with database management applications such as SQLs. Database will be used to store data that will be used for analysis.

Specific Performance (Success) Criteria:

1. Use of Eye Aspect Ratio to precisely detect user's blinking
2. Original Algorithm for Calculating Instantaneous Blinking Rate
3. Error-Checking mechanism for users whose eyes are not captured by computer camera (either because user is not or partially looking toward the laptop camera)
4. Use of specialist, third-party library for instantaneous screen brightness reactions
5. User-friendly Alarm Center where user can set the parameters such as duration of screen-break time
6. Use of linked list to store data from blinking rate algorithm
7. Virtual Eye Exercise using Moving-Cursor
8. Virtual Eye-Sight Testing using Snellen Chart