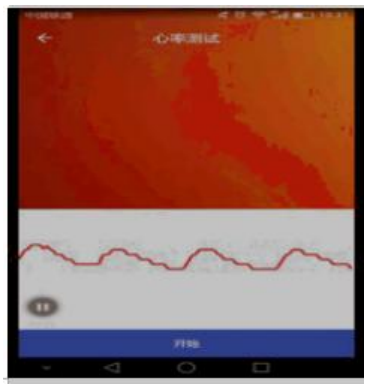
Abstract: The camera in the phone could be utilized to **monitor the heart rate**. Due to the importance of the heart rate, it is convenient for us to monitor the heart rate with our portable smart phone. The camera could obtain **the signal** from the **variation of average number of red elements** in the **image from the pressing hand**. However, pressing only one hand to the camera might cause the **motion artifact of human hands**, which could lead to **inaccurate estimating the heartbeat**. In this report we propose a method to **resolve the issue of noise caused by the motion artifact**.

Introduction: The **camera** in the phone could be utilized as a **heart rate monitor**, by turning on the camera and flashlight, then pressing the finger on the camera, eventually the app could obtain the **average number of red elements** in each frame of the image, and the heart rate could be generated based on the **fluctuations of average number of red elements** in the image. Heart rate can serve as an indicator of cardiovascular health.

Because Heart rate can serve as an indicator of cardiovascular health, getting the accurate heart rate is so crucial to our health.

Observation and Measurement: When I start the app and press my finger to the camera, I could get the impulse of my heart rate.



Research Issue: The **motion artifact** of human hands could lead to **inaccurate estimating the heartbeat from signals obtained from the camera**. From the perspective of the time domain, the **periodic motion artifact** introduces **false periodic peaks** in the original signal, whereas the **non-periodic motion artifact** generates **instantaneous distortions** in the raw signal. So, both **types of artifacts pose inaccurate detecting peaks**, leading to notable errors in estimating the heartbeat.

Conclusion: To address the problem of noise, by using **more channels to detect the heart rate,** the app could identify the accurate frequency of the heart rate. Let's discuss in a top-down approach.

From the perspective of user, because now there are more than one camera in the smart phone, **the use should use two fingers to press the two camera separately when the apps start detecting the heart rate**.

The reason why we use two channel is due to the noise **in the two camera is independent**, which indicates **we could compare the resulting spectrums from the two channels and identify the real frequency of heart rate**.

Step1 Calculating **the means of the estimating heart rate R_mean from the two channels**.

Step2 **FFT** to the two channels.

Step3 Select the **closest peak to R_mean**.