CS6650
Smart Sensing for Internet of Things
Course Project

Submitted by:
CS18B019 Karedla Roshini
CS18B025 M Harini Saraswathy
CS18B045 Rishika Varma K

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Objective:

The objective of our project is to calculate the heart rate through as less computation as possible. In this project, we have calculated the heart rate from facial video. We have used cpp language to reduce the executable size and also the running time of our algorithm. We have also listed the observations we have found with variations in the video like fps and resolution of the video. We are motivated from the applications we have surveyed in our homework 1, which calculated heart rate from face rather than finger.

Experiment:

To achieve our objective, we started by reducing library dependencies which tend to occur when coding in python. We wrote a peak-finding algorithm in cpp in the interest of reducing the executable size. We tested our new application on various facial features to see which parts of the face are better for this purpose. We also checked the robustness of our code by varying the video parameters in post-processing. The results for the heartrates measured in these variations, specific to each part of the face is shown below and charted for eavh video for clarity.

Observations :

We see below the effect of varying the fps or the video on the measured heart rate on readings taken from different parts of the face :

Note : In some graphs the variations of FPS are labelled as X due to issues in the graphing software.
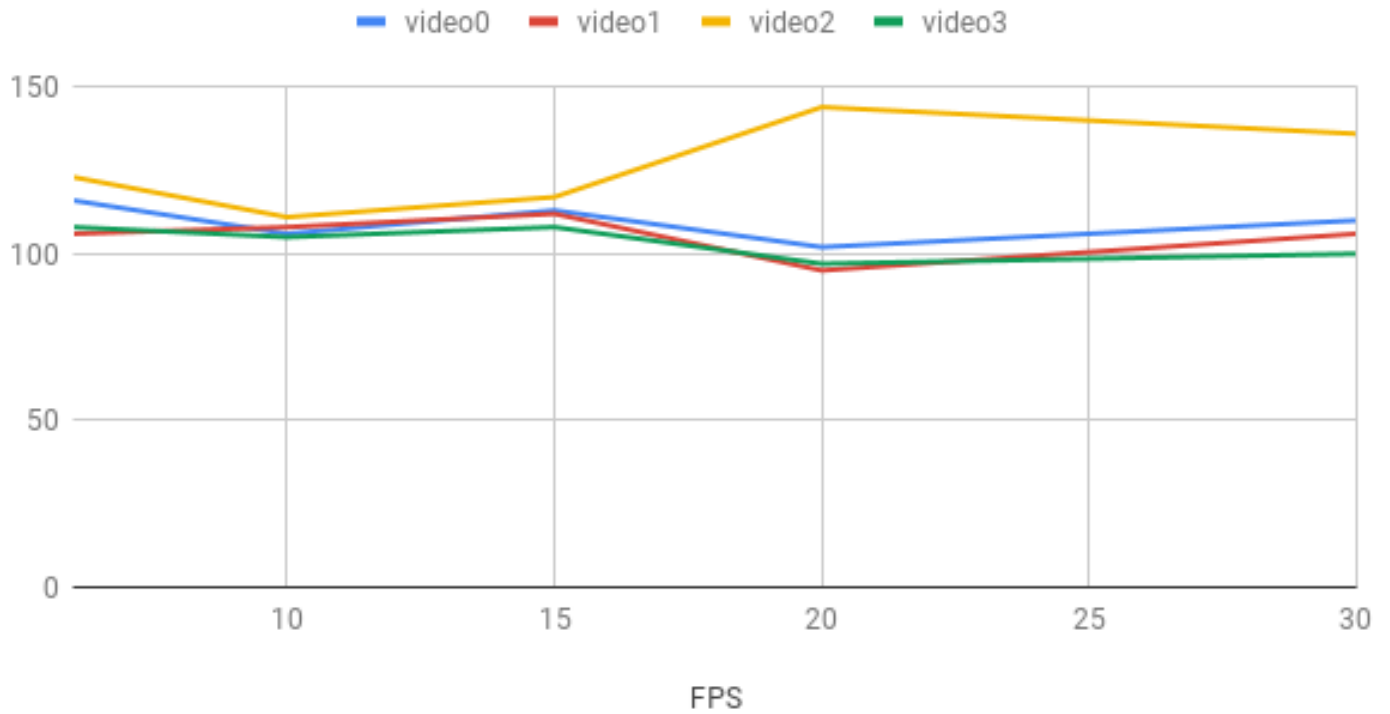
Full Face :
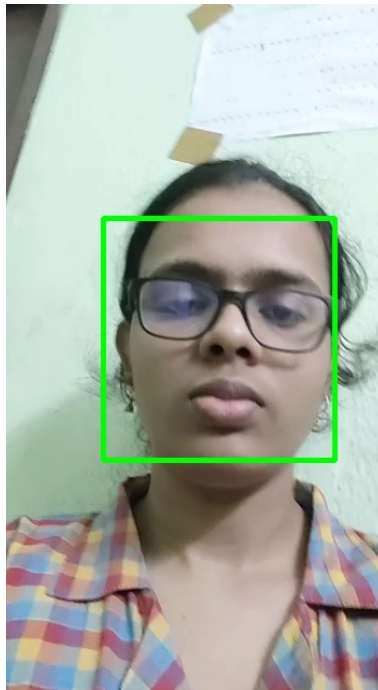
Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	116	106	123	108
10	106	108	111	105
15	113	112	117	108
20	102	95	144	97
30	110	106	136	100

Graph:

Heartrate chart for Face

Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	100	97	125	90
864*1536	104	99	129	99
972*1728	110	106	134	100
1026*1824	110	106	136	100
1080*1920	110	106	136	100

Graph:

Heartrate chart for Face
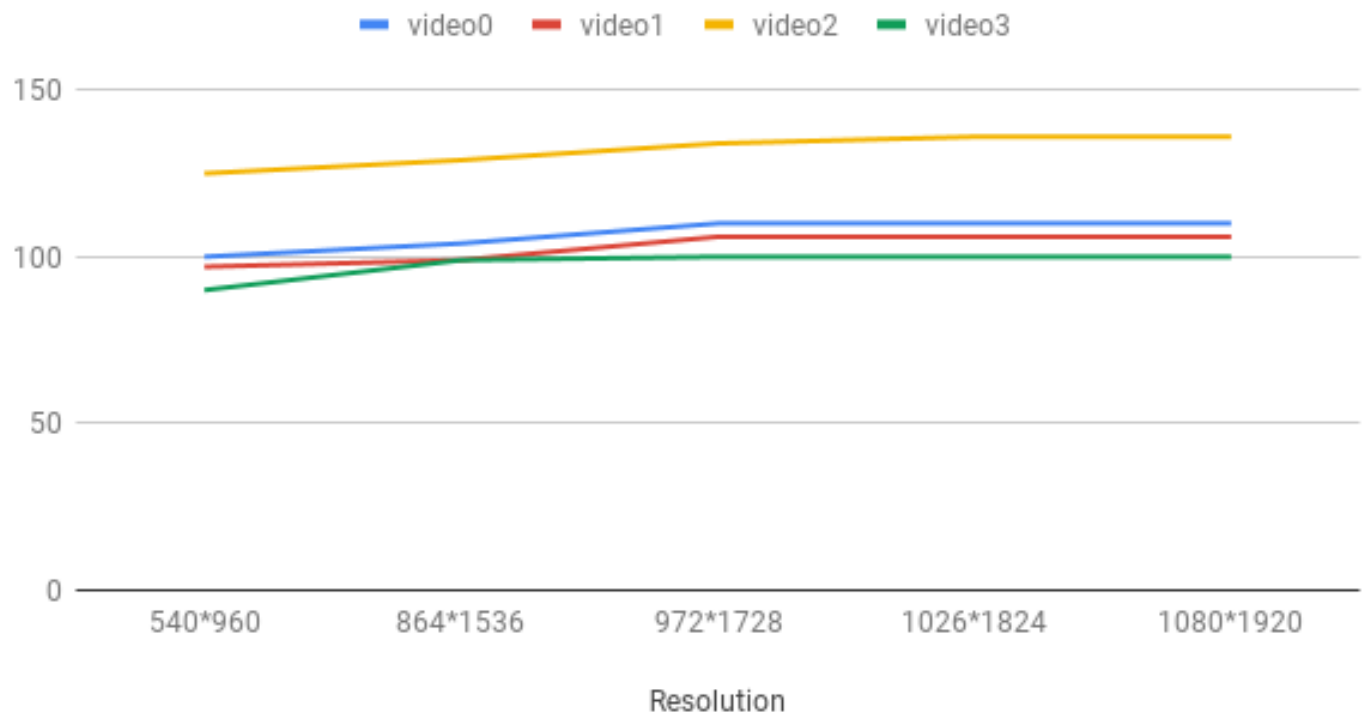
Forehead :

Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	80	80	94	74
10	99	88	88	87
15	101	61	98	65
20	97	69	88	77
30	57	62	87	65

Graph:

Heartrate chart for Forehead
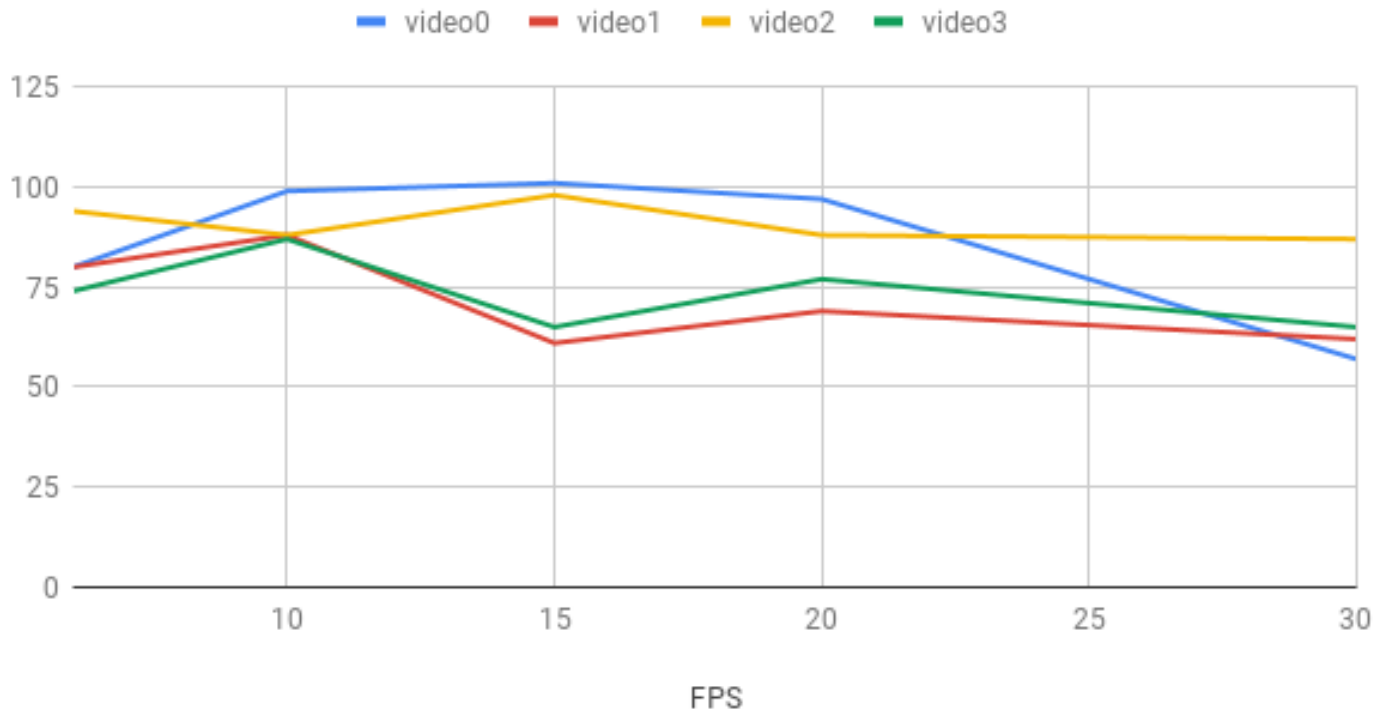
Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	40	50	76	58
864*1536	55	59	85	64
972*1728	57	62	85	65
1026*1824	57	62	87	65
1080*1920	57	62	87	65

Graph:

Heartrate chart for Forehead
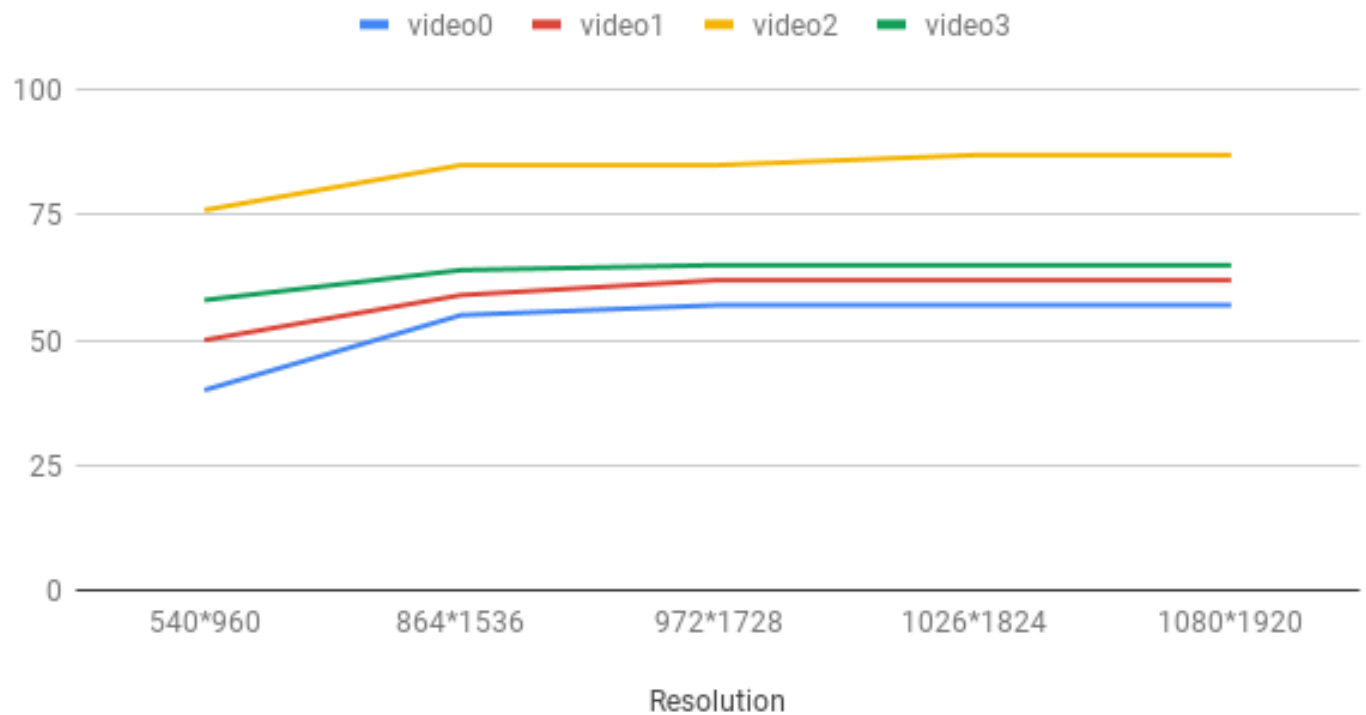
Nose :
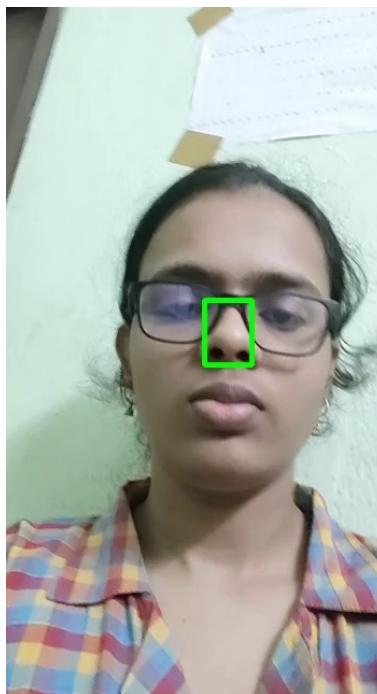
Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	61	100	80	65
10	55	101	77	75
15	50	96	79	65
20	42	119	63	65
30	65	91	70	62

Graph:

Heartrate chart for Nose
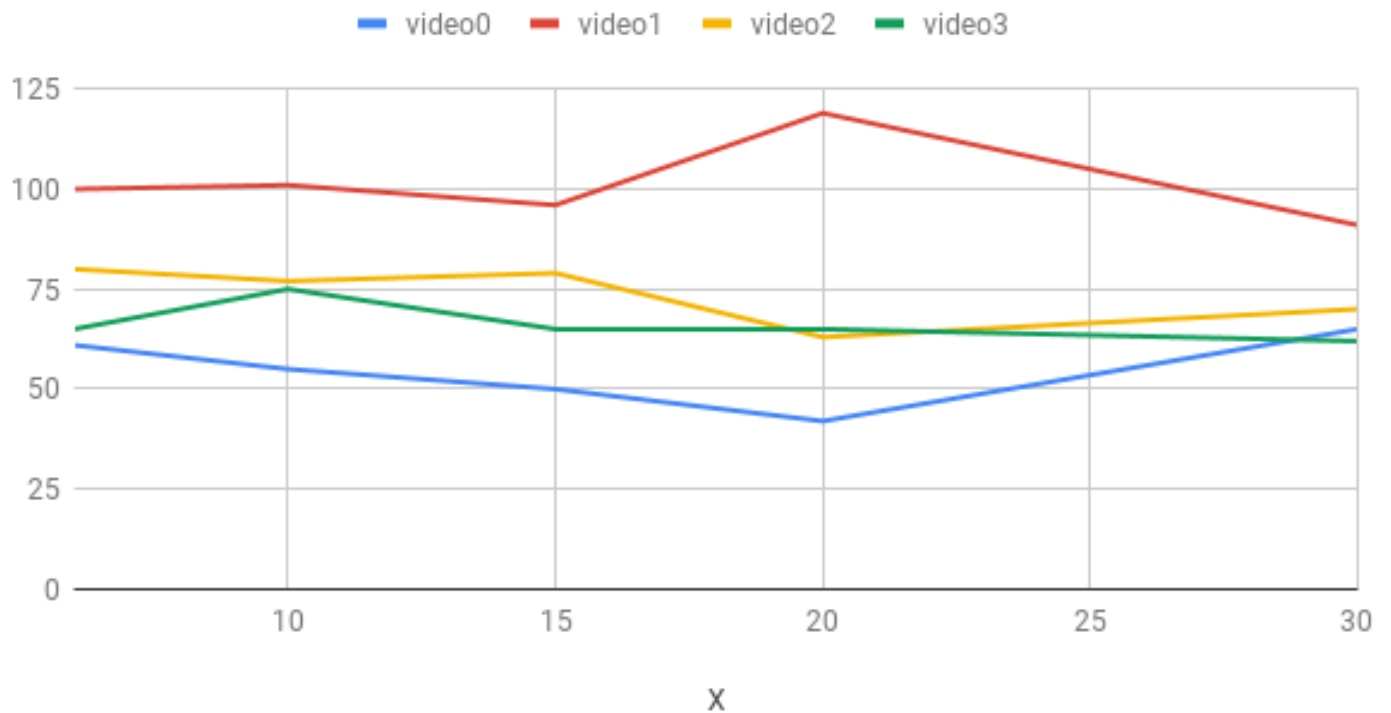
Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	60	85	64	48
864*1536	63	89	67	60
972*1728	65	91	70	62
1026*1824	65	91	70	62
1080*1920	65	91	70	62

Graph:

Heartrate chart for Nose
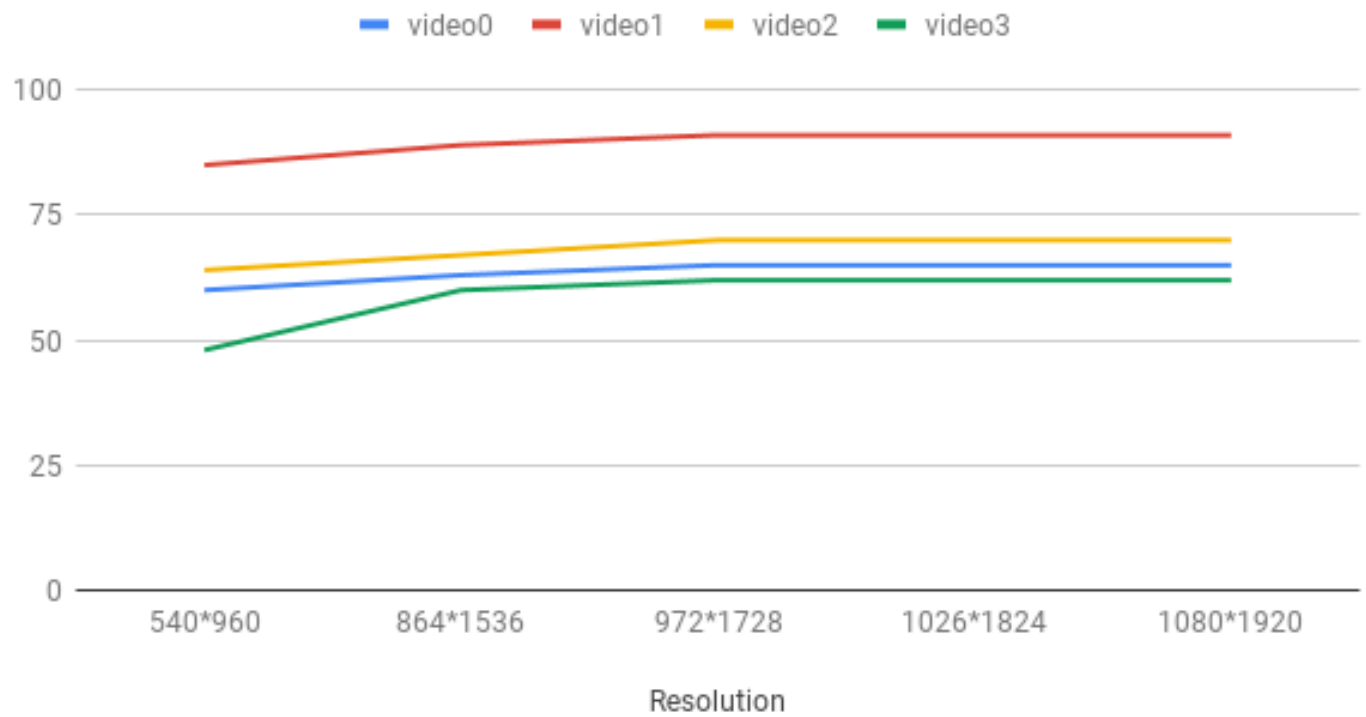
Left Cheek:

Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	85	98	82	72
10	95	100	91	75
15	62	58	98	75
20	85	58	95	48
30	90	73	101	62

Graph:

Heartrate chart for Cheek 1
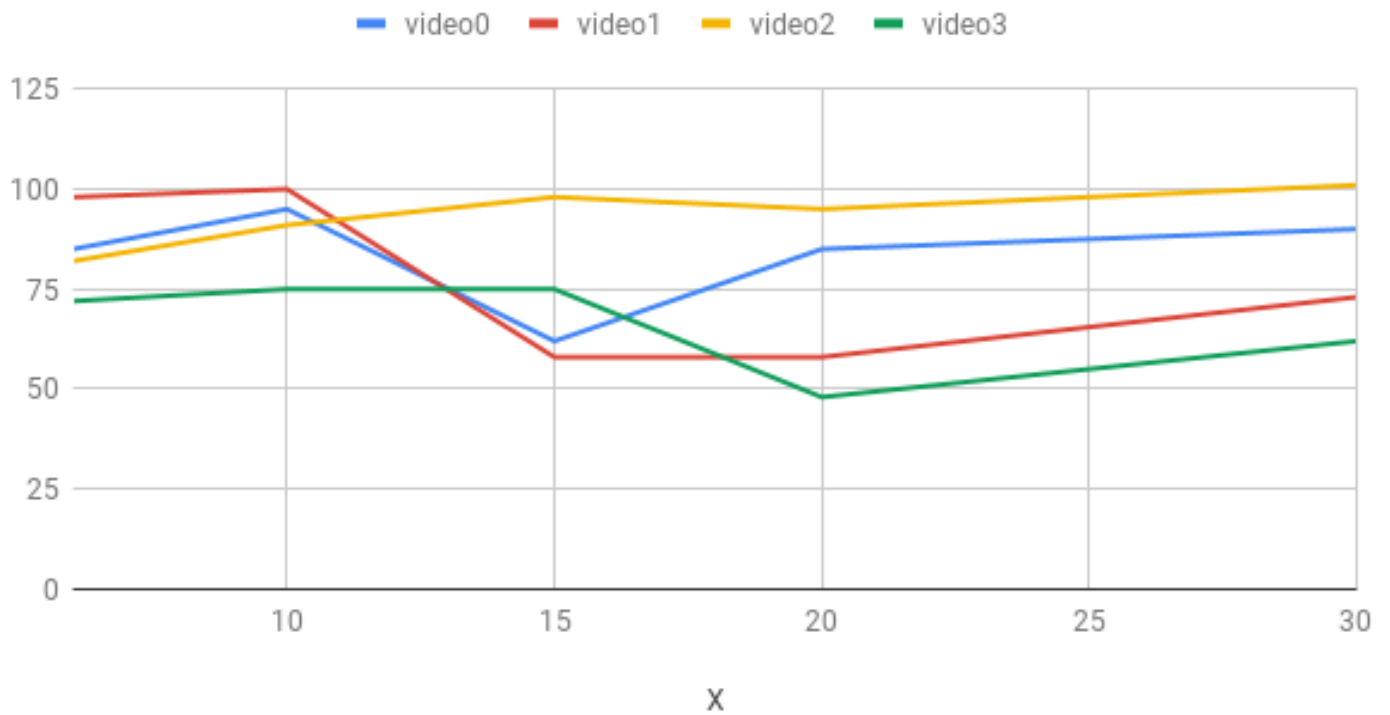
Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	83	70	87	54
864*1536	83	70	96	60
972*1728	90	73	100	62
1026*1824	90	73	101	62
1080*1920	90	73	101	62

Graph:

Heartrate chart for Cheek 1
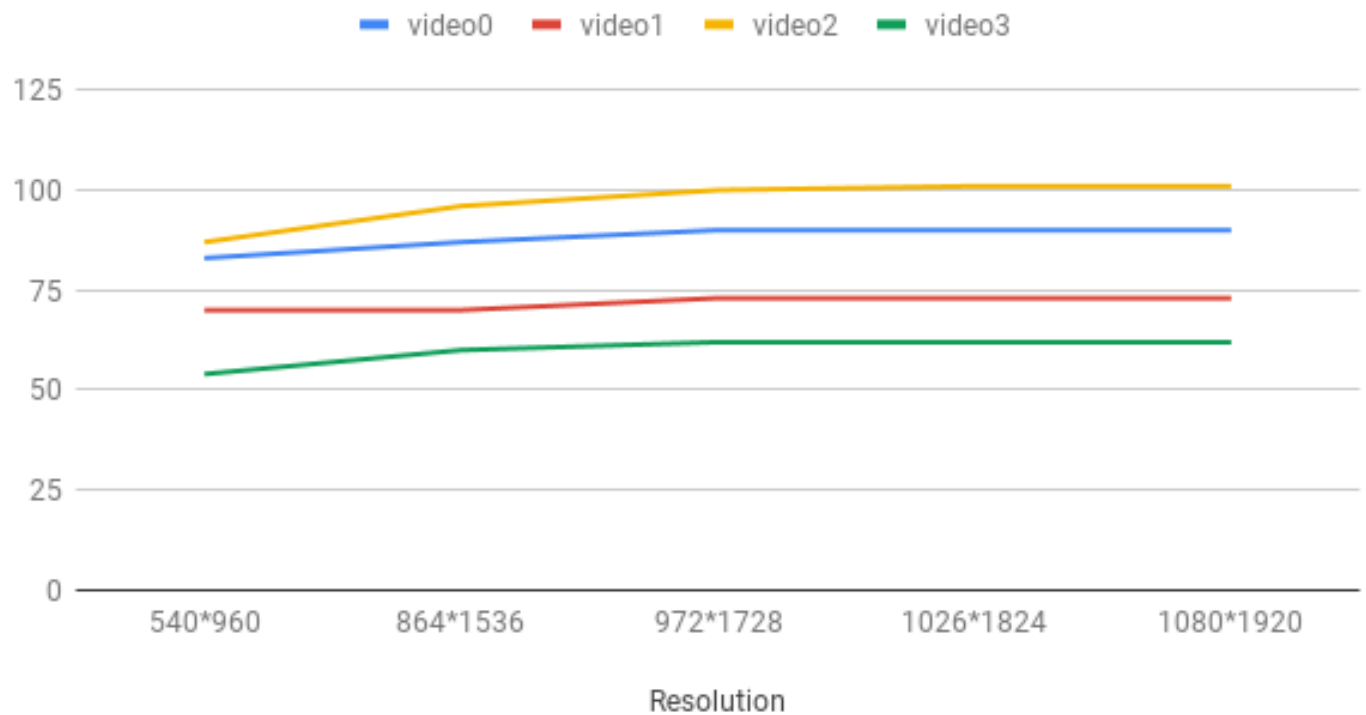
Right Cheek:

Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	103	61	94	58
10	97	65	82	62
15	62	46	46	54
20	93	58	77	44
30	82	52	80	27

Graph:

Heartrate chart for Cheek 2
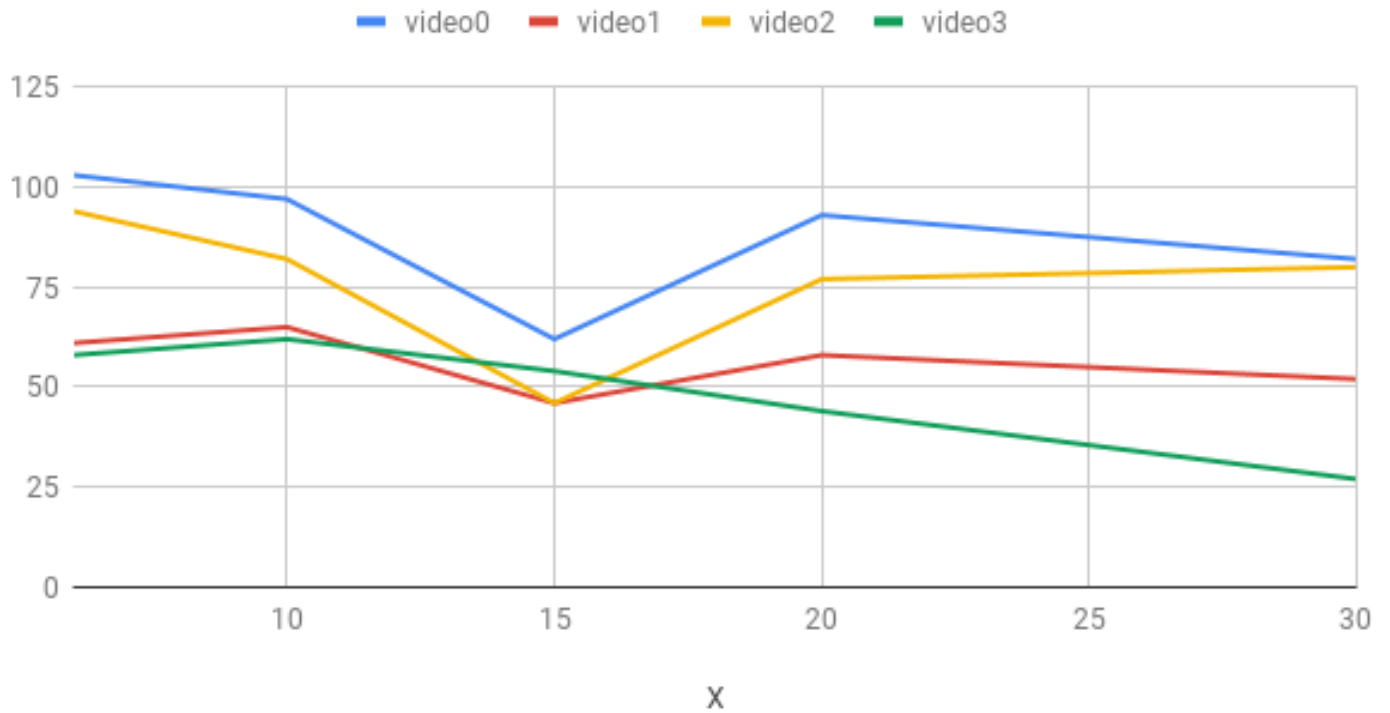
Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	69	48	73	19
864*1536	79	50	77	24
972*1728	82	52	80	27
1026*1824	82	52	80	27
1080*1920	82	52	80	27

Graph:

Heartrate chart for Cheek 2
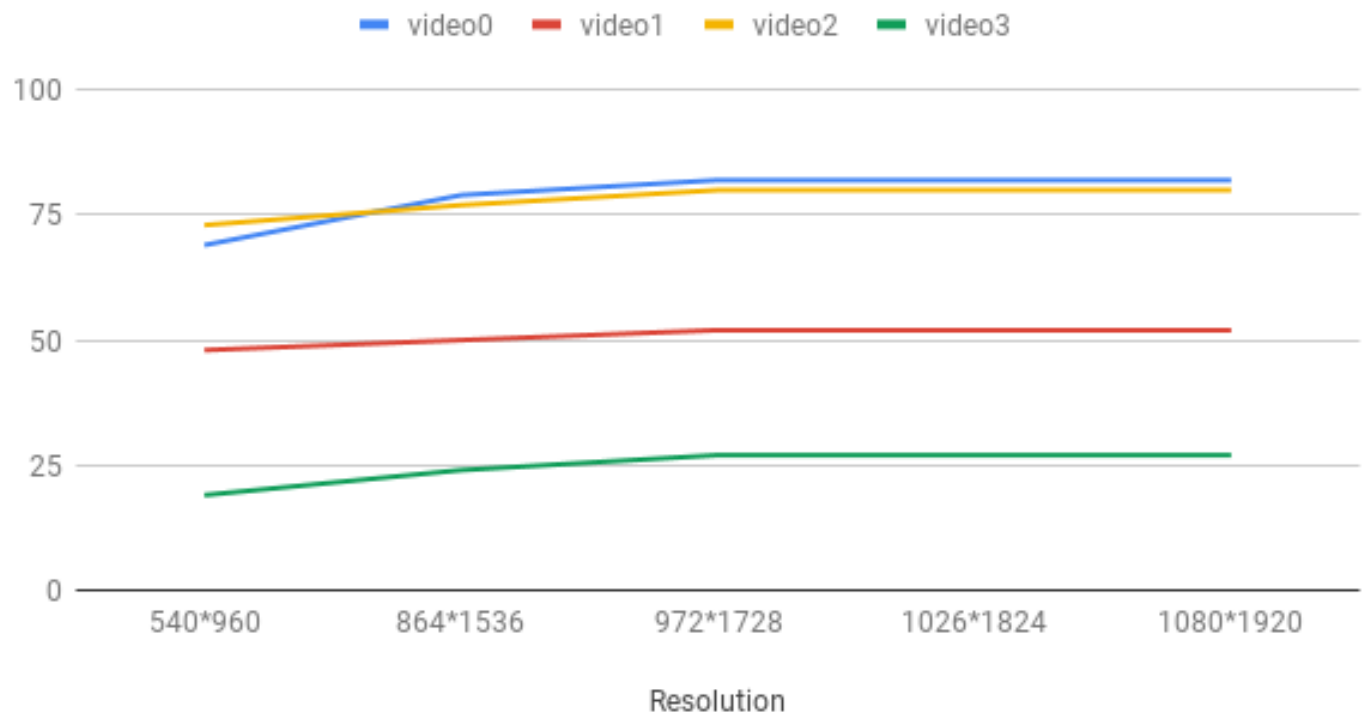
Chin :

Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	82	58	86	58
10	78	61	91	75
15	56	69	51	37
20	89	49	81	52
30	70	52	68	51

Graph:

Heartrate chart for Chin
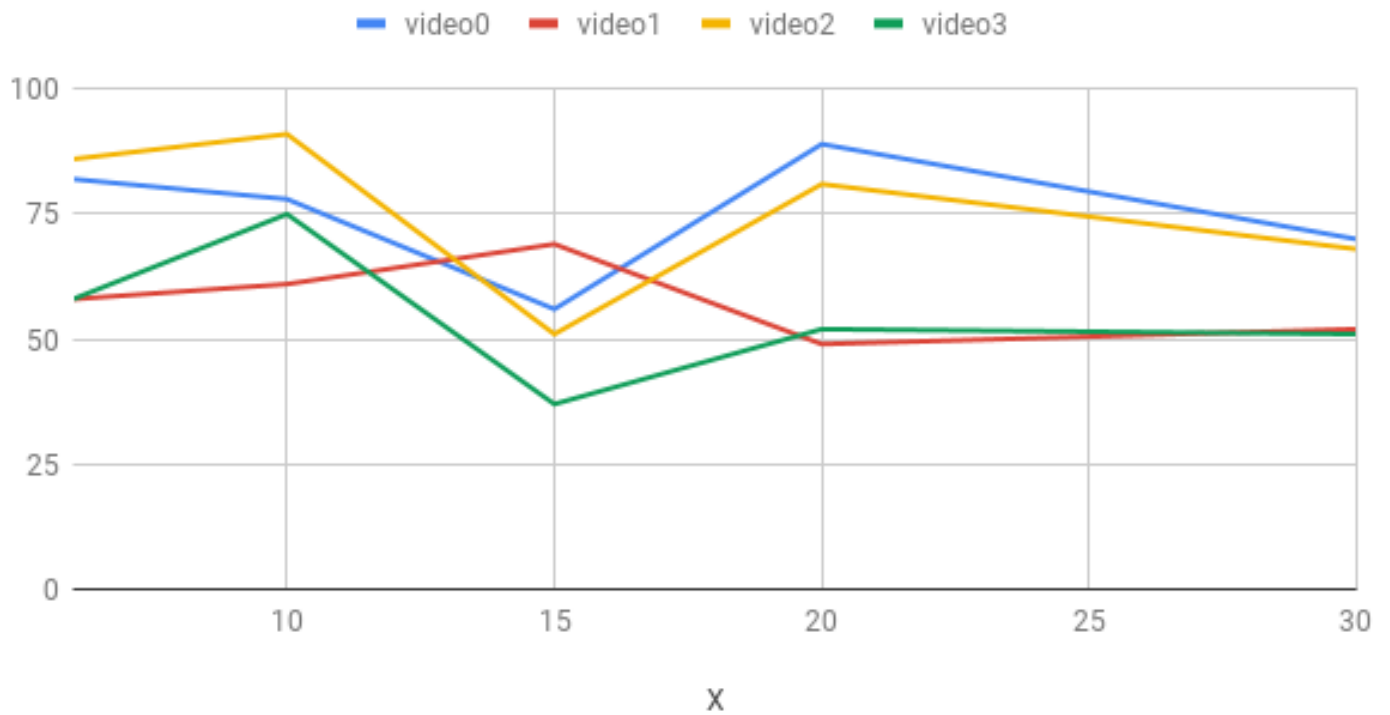
Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	64	39	48	39
864*1536	69	51	67	49
972*1728	70	51	68	51
1026*1824	70	52	68	51
1080*1920	70	52	68	51

Graph:

Heartrate chart for Chin
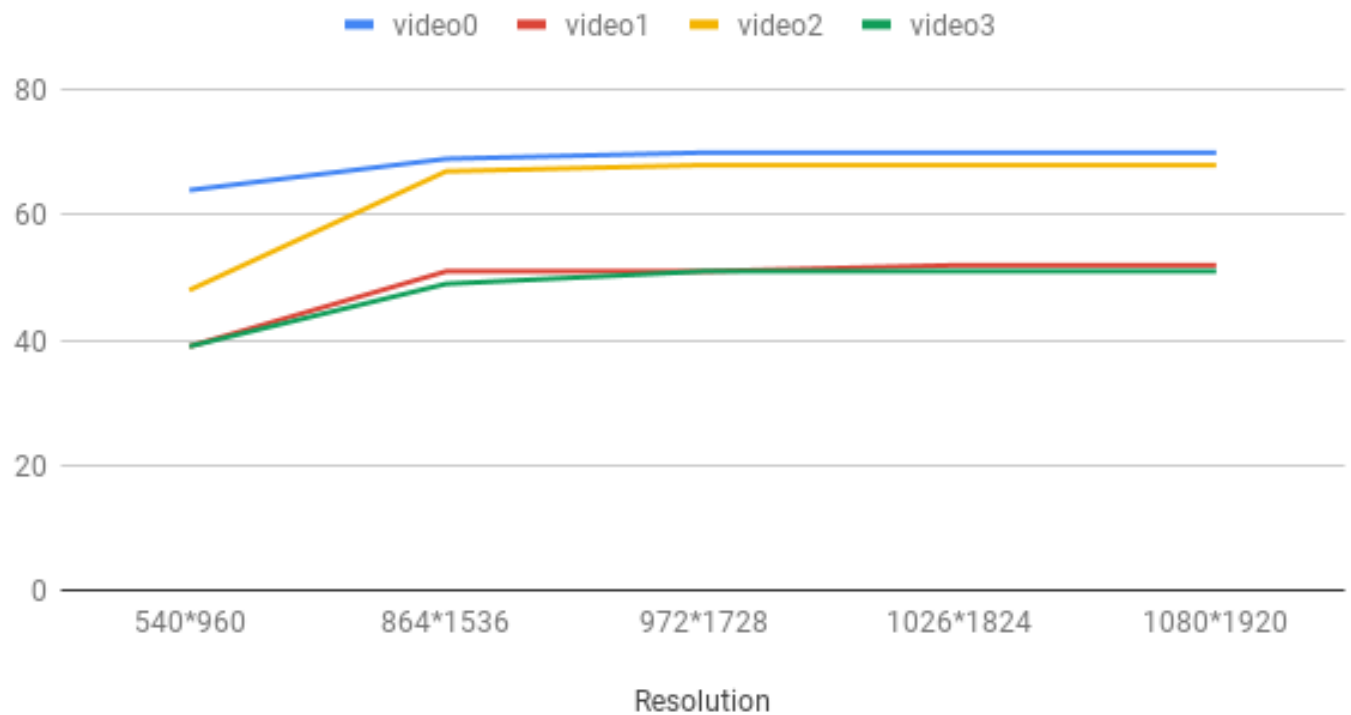
Lips :
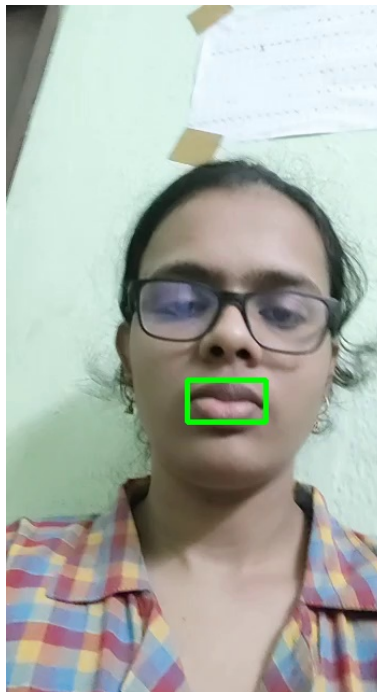
Readings wrt varying FPS:

fps	video1	video1	video2	video3
6	61	67	98	65
10	65	66	104	65
15	62	58	89	59
20	46	63	84	48
30	42	40	91	51

Graph:

Heartrate chart for Lips
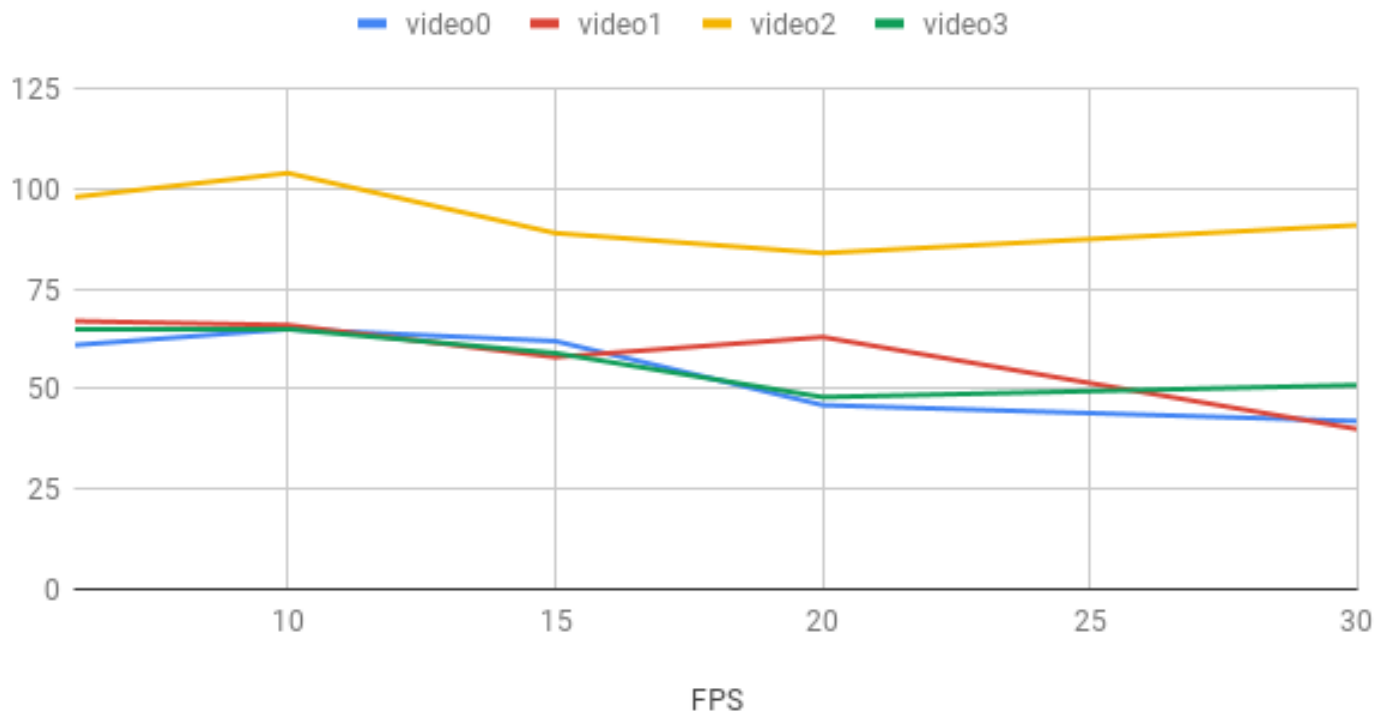
Readings wrt varying Resolution:

Resolution	video1	video1	video2	video3
540*960	37	31	82	40
864*1536	40	38	88	48
972*1728	42	40	91	51
1026*1824	42	40	91	51
1080*1920	42	40	91	51

Graph:

Heartrate chart for Lips
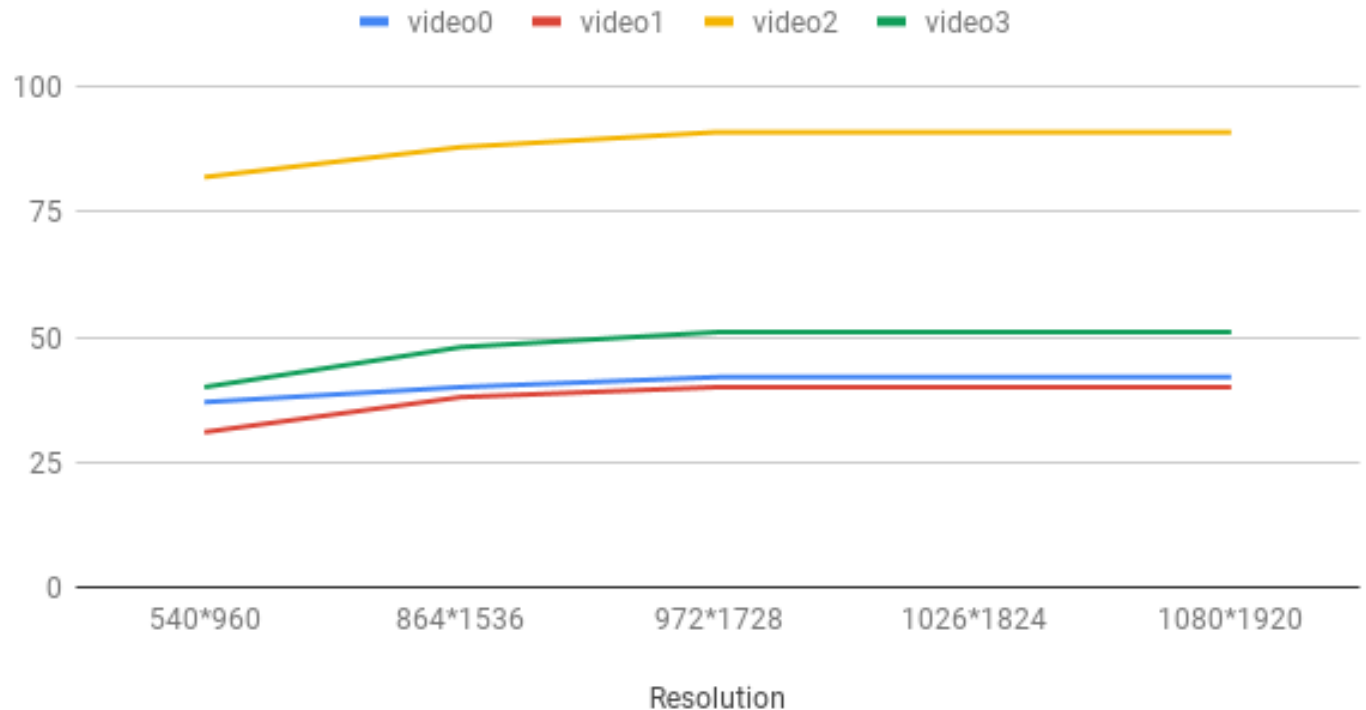
Conclusion:

- We compared the heartrates measured from various parts of the face and compared it with the true value measured by us. This showed the accuracy to be highest when measuring from the forehead, which is as expected. (As veins are more easily visible in the forehead when compared to parts like cheeks which have more fat and nose which has more cartilage affecting the readings.)

- The values measured from the entire face were much higher as this takes into account far more noise from external surroundings as well as the eyes, ears etc which are far from ideal for this analysis.

- We saw that varying fps caused changes in the heartrate measured as the number of peaks measured will not remain in the same proportion to the number of frames analysed. However, we can see that FPS variations only below a certain value cause dramatic changes, while small manipulations do not affect too much.

- We also saw that varying resolution caused very minimal changes in the beginning, as we dropped a few pixels. However, drastic changes in resolution are drastically seen as the number of peaks measured by the code lessens.

- Finally, we wrote the algorithm to identify peaks and calculate heartrate in cpp, thus resulting in a much smaller executable size. This is preferable to the earlier case where we had a highly

functional, machine heavy executable. As the size of executable is smaller, we have also reduced runtime of the application.

Contributions:

- CS18B019 : Peak finding upon pixelated data, heartrate calculation and all related content

- CS18B025 : Observing robustness, varying facial features for measurement and all related content

- CS18B045 : Video postprocessing, feature recognition and all related content