Homework 1

(MAX SCORE: 100 points)

The task is to develop a PPG system using a smartphone device to capture blood flow related imagery data and post-process such data to estimate the pulse rate of the subject.

Task 1: A Survey of relevant PPG applications [MAX SCORE: 15 points]
Navigate to the Google Play Store and shortlist a few pulse rate/SpO_2 sensing apps (3 is good) that you find interesting. Submit a brief writeup (3-4 lines) for each of the apps you have shortlisted, as mentioned below.

a. Why do you find them interesting?
b. Is it an outcome of an academic research lab? Are there any research papers or articles linked to it? Is it a startup doing it?
c. Anything associated with the app that you find unique.
d. State a couple of good things the app does and are missing in others.
e. State a couple of glitches that you feel the app has.
   For points d & e, restrict yourself to just the sensing, performance, latency, stability, robustness of the sensing. Do not judge based on fancy UIs, nice animations etc.

Task 2: Generating test video/datasets [MAX SCORE: 25 points]
Use your smartphone's camera to capture the blood-flow video. Turn on the flash while recording and turn it off once done. Capture the video using the maximum frame rate that is available in your phone (e.g., 60 fps). The same holds for image resolution. The captured videos are saved on the device's SD card. (*Don't move your finger/hand randomly or press too hard against the camera or flash while recording*.)

Copy the video on to your computer and post process the video using your custom application (use C/C++/Python). Set configuration parameters for the processed video: Frames per second Resolution or Dimension.

Task 3: Sensing Algorithm [MAX SCORE: 25 points]
Input -> Proceeded Video
Output -> BPM (sliding window), reported say every 5 seconds.
Remove noise, make attempts to make the algorithm stable and robust so that it has the same desired output for data collected under various conditions.

(a) Time-series data [15 points]
Find the BPM using your algorithm that leverages the time series of the RGB pixels.
(b) Use DFT [10 points]
Use a fourier transform to obtain the pulse frequency directly from the time series.

Task 4: Evaluate the performance of your algorithm [MAX SCORE: 35 points]

Change the frame rate of the video (choose 1 every N frames, to downsample).
Similarly, change the resolution of the video (choose 1 every K pixels along X and Y axis).

Run your algorithm again on this video.
a. How much can you come down in terms of FPS, any thoughts on this/why? Show whether it works/doesn't work. [5 points]
b. What about low resolution? Any portions of the video that do not change? Remove them to bump up the SNR? Describe your technique. [15 points]
c. Is there a trade-off involved here? Low resolution vs Low FPS? Discuss based on your data. [15 points]
Draw conclusions using a data set (at least 10 original videos, each about 30 seconds long)

Deliverables | Submit by: 19th March, 11:59PM (Friday)

1. A fully detailed report summarizing your activities, figures, plots etc., with all references.
2. Source code including all references, web repositories consulted.
3. Raw-data (video files, traces, processed videos in organized folders)
4. A README file documenting the contents and methodology to run the code. Also mention the names of all students with whom you have discussed your homework with.
5. I may ask you for a separate meeting in case I need help understanding your submission.

Upload the content as a zip file in your google drive folder and email me the link.

Name of zipfile: [CS6650_HW1_<rollnumber>.zip]
Email subject: "[CS6650 HW1 <rollnumber>]"