Web Application that shows Real-Time Heart Rate Measurements From a Human Face Using a Webcam Feed

Report Name	Outline Project Specification
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1.   Project description

My project is to create a web application in JavaScript that uses a webcam, which is pointed at a user's face, to calculate their heart rate. Using the paper "Robust Contact-Free Heart Rate Measurement from Human Face Videos Using a Webcam" [1], which was written by Muhammad Waqar, Reyer Zwiggelaar and Bernard Tiddeman at Aberystwyth University, which talks about a technique of sampling the skin and analyzing the changing of the skin color over each frame to build up a representation of a heart rate.

In the paper, they used a webcam to record videos of people's heads looking straight into a webcam. They then would run these videos through a series of scripts using different programs such as for tracking they used OpenCV in C/C++ and the analysis of the video using various matlab scripts to get the final heart rate out.

In my project, I will try to make the process real-time, by using JavaScript and wrappers for OpenCV to do face detection. I will then try to recreate the algorithms used in matlab to do the analysis on the data to give back a heart rate in real time. One of my aims is to make sure the user does not have to download any plugins or external software to make it work.

I believe making this technology available as a website and real-time will have many applications in the real world such as heart rate monitoring on the go and analyzing patterns while you're at your desk working.

2.   Proposed tasks

The first area is going to be about getting the sample of pixels to run the analysis on. To do that I will need to access the webcam feed and send it to the server over sockets. I will need it on the server for the next task which is face detection. This must be done on the server as currently I will be using OpenCV to do the task. I plan to spend some time researching this area as ideally I would like to use a pure JavaScript approach so I do not have to send all the streaming data which would slow down the processing as it would be a lot of data. From the face detection, I will then be able to sample the cheek area to do the analysis.

The next area is the analysis this area is a lot more of an unknown to me and I expect it to be a lot harder as there will be less help available online. I will start off with implementing a robust mean algorithm, for this I will need to split my signals to RGB which should be easy with OpenCV. I believe robust mean will take a while to implement due to a lot of complex math and I need to research more into the details of robust mean. With the means I then need to run two different analysis approaches on the data, detrending and independent Component Analysis. This will just be implementing mathematical formulas where I should be able to use other code to refer to when writing. I then need to find the heart rate signal using a method called PPG signal Identification. A stretch goal of the product is going to be implementing a filter based pulse signal Extraction due to the complexity of completing it.

3.   Project deliverables

In the progress report, I plan to deliver a document which gives a clear indication of the items I have finished, working on and not started. I will give an updated plan for items to be completed and I will be able to give a better idea of whether the project will hit the final deadline.

I plan to make two types of documentation, one of a detailed description of the implementation so it can be taken further by others and so people know how to run the program. The second will be documentation of how to use the website and the features which are available.

Pulse signal extraction as stated above is a stretch goal which will bring a fair bit of work so this will be a separate deliverable for me.

I will have the actual project to deliver which will be in the form of source code and a website with a demo to show off its features and how it all work.

The last deliverable is the final report; this document is about the process I took and how I delivered my software. That will include the challenges I hit and how I organised myself to meet my deadlines.

4.   Initial annotated bibliography

[1]   Muhammad Waqar, Reyer Zwiggelaar and Bernard Tiddeman. Robust Contact-Free Heart Rate Measurement from Human Face Videos Using a Webcam", Unpublished. Available form Aberystwyth Computer Science Department

This paper is unpublished, at the moment, but it is the basis for my projects. It describes the techniques that are needed to be implemented to get good results out of the webcam feed. It was created in Aberystwyth by Muhammad Waqar, Reyer Zwiggelaar and Bernard Tiddeman.