SmHeart Rate Detector

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Goal

- ❑ Design and implement a program that can detect heart rate and recognize a subject's heart rate signal when comparing to a database of multiple subjects' heart rate signals .

Motivations and Objectives

- ❑ Motivations
  - Allow a noninvasive way to detect heart rate.
  - As biometrics are becoming more prevalent in modern technology, heart rate can be the next big identifier.
  - Allows the user an additional form of authentication using a very specific unique identifier.
- ❑ Objectives
  - Detect the subject's heart rate from a one minute video in good lighting and simple background.
  - Design a database containing multiple subjects' heart rates to be used as a means of classifying any subject.

Research Challenges

- ❑ Obtaining optimal lighting and background for sample videos to be prepared.
- ❑ Specs of computer hardware were below recommended level causing long durations of code implementation
- ❑ Filtering the raw data generated from the movements of the head would often result in loss of results.

Acknowledgement

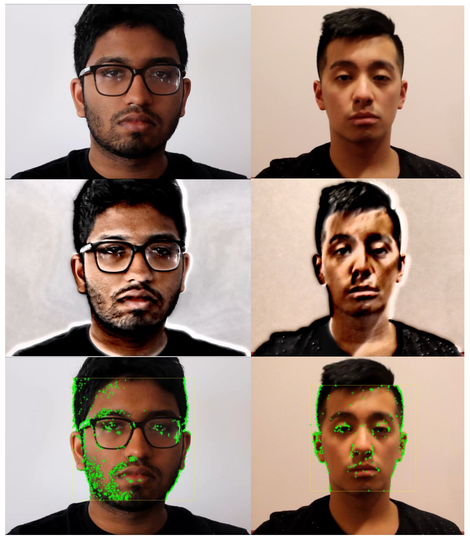
We would like to thank Professor Vishal Patel for his guidance and support throughout this project, and MIT for their magnification code and paper.

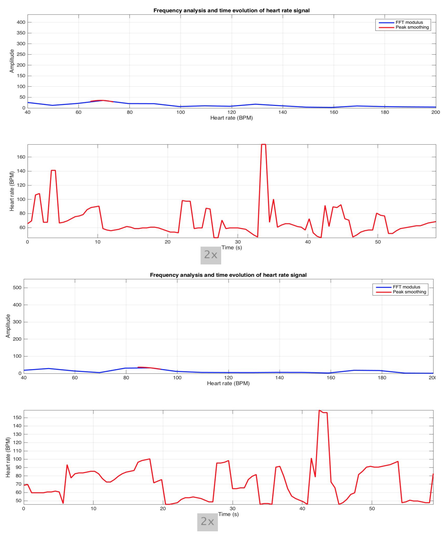
References

[1] http://people.csail.mit.edu/mrub/vidmag/
[2] https://github.com/uavster/Video2HeartRate/blob/master/process.m
[3] http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6996246&tag=1

Methodology

Video of Person → Eulerian Magnification → Feature Tracking → PCA Decomposition → Filtering → Peak Detection → Dynamic Time Warping (DTI)





- ❑ Capture 1 minute video of subject with optimal lighting and background
- ❑ Enhance movement of subject's face in video using Eulerian Magnification
- ❑ Use feature tracking to obtain the subject's face and place feature points
- ❑ PCA decomposition is done on the facial feature points matrix and picked the best signal generated by motion in the feature points
- ❑ Noise was filtered out from the best signal
- ❑ Peak detection was used on the filtered signal to estimate the BPM
- ❑ Using dynamic time warping, one signal was compared to other signals in order to determine similarities and identify individuals

Results

Kardia BPM Calculation vs SmHeart Rate

Test	Kardia Average BPM	SmHeart Rate Average BPM	Percent Error (%)
1	72	71.36	0.88
2	81	77	4.93
3	78	76	2.65
4	69	68.94	0.08
5	66	64.07	2.92
6	70	70.89	1.26
7	77	75.58	1.88
8	100	68.24	31.76
9	85	73	14.11

Biometric Comparison Between Heart Rate Signals

Subject A
Subject B
Subject C

Test	Subject Signal Result	Subject Signal Actual	hit/miss
1	A	A	hit
2	B	B	hit
3	C	C	hit
4	C	A	miss
5	C	B	miss
6	C	C	hit