

Autocorrelation-Based, Non-Contact Photoplethysmography: Computationally-Efficient, Noise-Tolerant, Extraction of Heart Rates from Video

Chadwick Parrish, Kevin D. Donohue, and Henry Dietz

ECE Department, University of Kentucky

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Outline

- Overview of PPG
- Goals of the Current Work
- Related Work
- Data Acquisition
- Data Processing
- Results
- Difficulties
- Conclusions



What is Photoplethysmography (PPG)?

- Basis of PPG
- Contact PPG
 - Pulse Oximetry
- Non-Contact PPG



Our Goals

- Low Computational Power
- Non Selective Filter Bounds
- Passive Algorithm
- Development for Real-Time



Related Work

- PPG Works Have Long Used Frequency Analysis
 - Verkruysse , UC Irvine
 - Green & Blue Channels
 - Bandpass Filter: .8-6Hz
 - FFT



Related Work

- Short-Term Autocorrelation is more recent
 - Das, Univ. of Calcutta
 - Contact PPG
 - Filters
 - $> .7 \text{ Hz}, < 33 \text{ Hz}$
 - Range Looked at is Between 50-120 BPM



Data Acquisition

Video ROI Tiler & Sampler

- Inputs
- Usage
- Sampling
 - FFmpeg
- Output

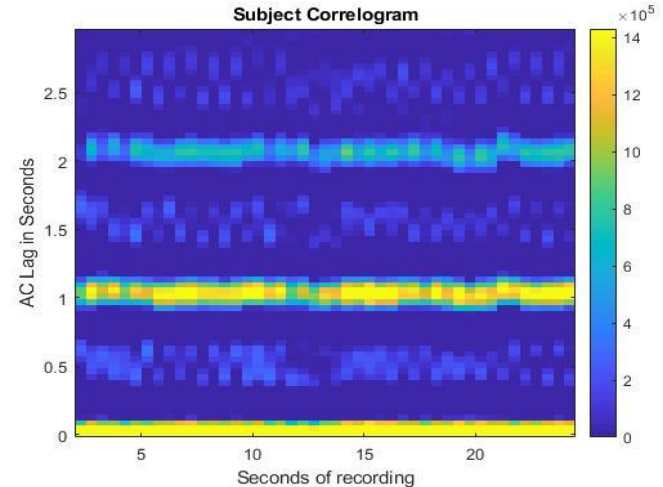
In-Camera Data Capture

- Input
- Usage
- Sampling
 - CHDK
 - Motion Detect
- Output



Data Processing

- Linear Detrend
- Filter
- Short-time Autocorrelations
- Outputs
 - BPM
 - Correlogram



Results: VIRTAS

Trial No.	Subject No.	Video Duration (in seconds)	Est. BPM (from Data Processing)	Ref. BPM *	Absolute Error in BPM
1.7	2	25	79.4	81	1.6
1.8	2	16	79.4	81	1.6
1.9	2	29	75.2	81	5.8
1.10	2	33	71.4	81	9.6
1.11	2	32	71.4	81	9.6

* obtained with active optical contact PPG sensor on subject finger



Results: In-Camera Data Capture

Trial No.	Subject No.	Est. BPM (from Data Processing)	Ref. BPM *	Absolute Error in BPM
2.1	1	75	68	7.0
2.2	1	68.2	68	0.2
2.3	1	65.2	68	2.8
2.4	1	71.4	68	3.4
2.5	1	68.2	68	0.2



* obtained with active optical contact PPG sensor on subject finger

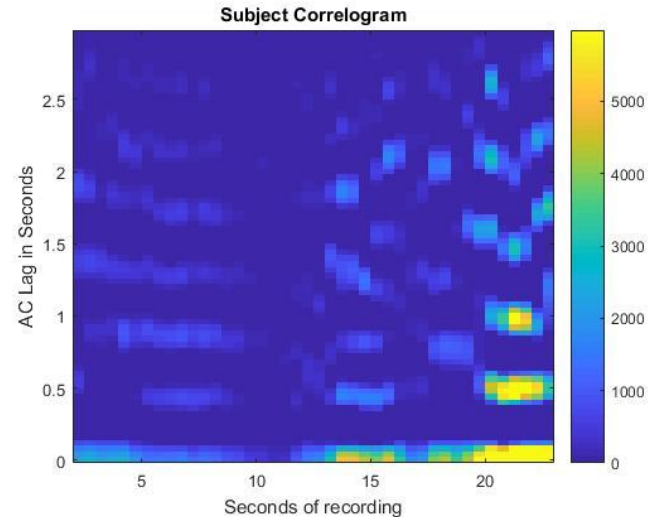
Results

- Absolute Mean Error
 - VIRTAS: 15.6 BPM
 - In-Camera: 8.38 BPM
 - Total: 11.87 BPM
 - Lighting Variance
 - Verkruysse



Difficulties

- Fill-in Lighting on the Face
- Low Framerate/Sampling Frequency
- High Noise and Low Energy
- Octave Errors



Conclusions

- What the current work has done
 - Low Computational Cost
 - Real-Time Scalability
- Future Directions
 - Embedded Real-Time Application (In Progress)
 - Multiple Subjects



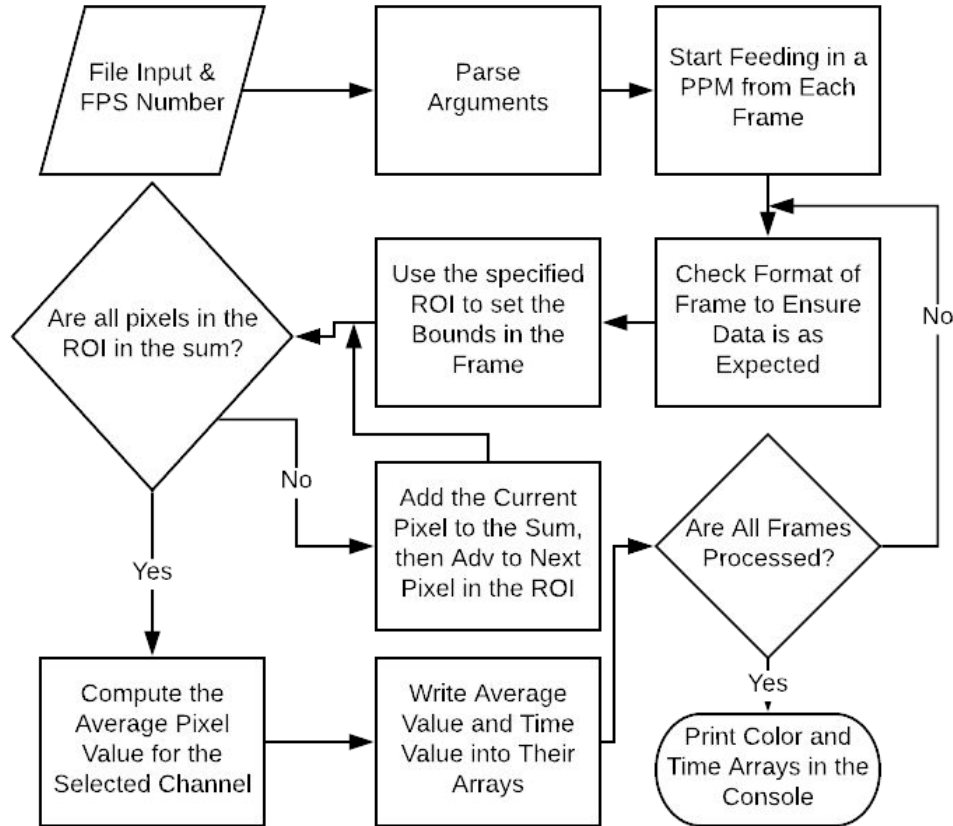
Overview

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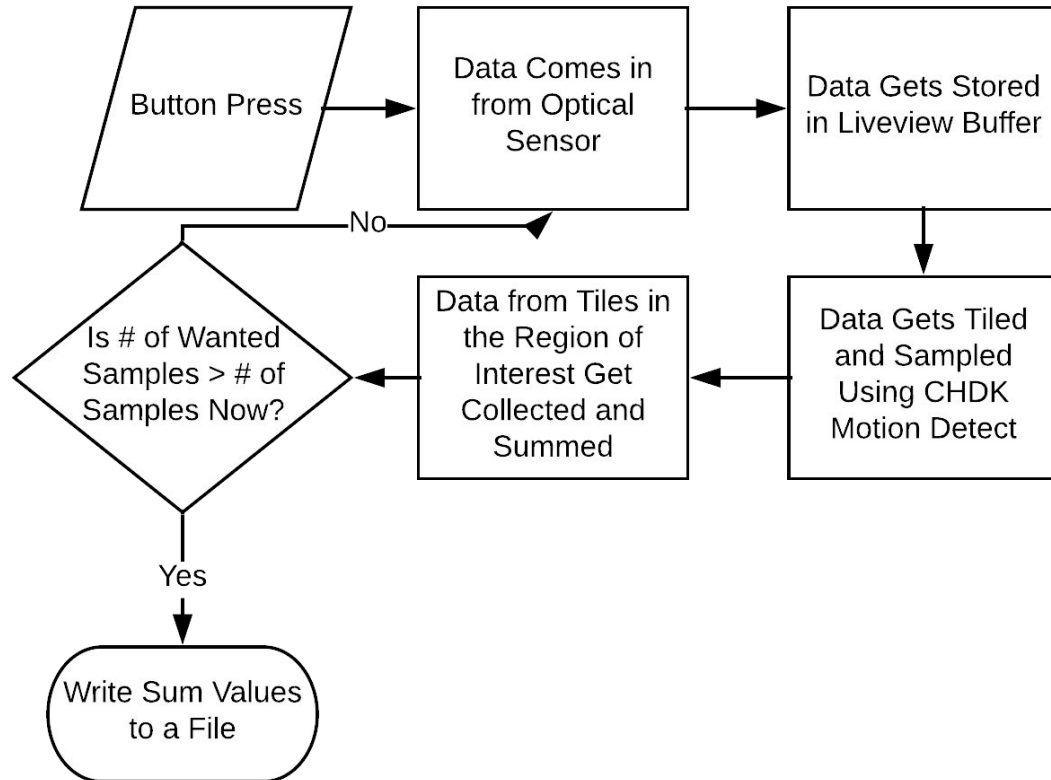


Questions?

VIRTAS Flowchart



In-Camera Data Capture Flowchart



Data Processing Flowchart

