

An Approach to Camera-based Contact-less Breathing Rate Monitoring



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Introduction

- Respiration rate (RR) is a key vital sign, and its proper measure is *crucial* to preserve life
- Contact-based methods to measure RR have issues with contact loss and are ineffective for those with certain physical conditions and infants
- An effective and efficient video-based approach could prove robust and safer for clinical use

Background Information

- Most current work investigates *computationally-heavy* solutions and uses *very limited* datasets
- **Key terms:** Respiration Rate (RR), Ground truth (GT), Fast Fourier Transform (FFT), Regions of Interest (ROIs), Spatiotemporal signal

Methodology

- Respiration data was collected from volunteers in several positions (about 3 minutes/sample) to create a *holistic large* dataset in lab environment
- A GT sensor and video sampled data to compare results of video with a contact-based benchmark
- Canny edge detection algorithm was applied to samples
- Signals for subject movement were derived by examining the number of points shown in frames along the X, Y, and X + Y axes
- An FFT was used to choose which of the 3 signals had the best quality for a given sample

Data Analysis



Figure 1. Subject Positions. In the study, subjects were sampled sitting facing the front, sitting from the side profile, and lying down. These positions allowed us to examine regions of interest (ROIs) for the shoulder, chest, and stomach.



Figure 2. Edge detected data frames. Once specific ROIs were extracted from the video, the Canny edge detection allowed us to isolate movements related directly to the RR.

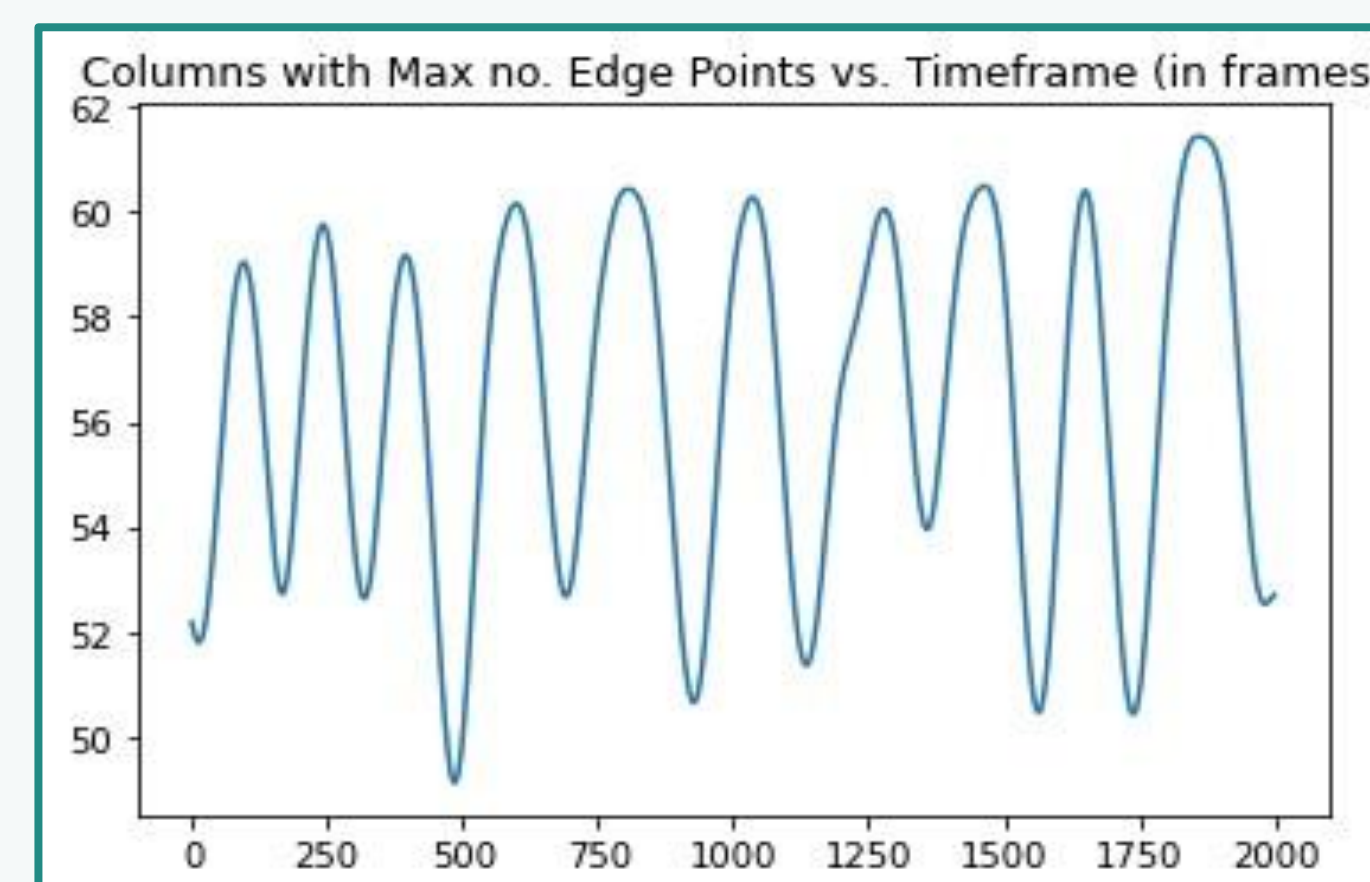


Figure 3. Filtered signal. In each frame, edge-detected points were summed along the y-axis and specific columns with max number of edge points in that given frame was plotted against the timeframe of the video. A Butterworth filter was designed to clean the signal.

Discussion

- Edge detection and the frame point analysis reveals a pattern of movement related to RR
- Further work to be done calculating RR, comparing it with GT signal, and examining accuracy of this technique
- Current limitations are with use of recorded signal and controlled environment with few anomalies; we plan to investigate ML to remove artifacts unrelated to RR and detect ROIs
- Proving efficacy of this technology could lead to safe and effective clinical use to monitor breathing

References

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