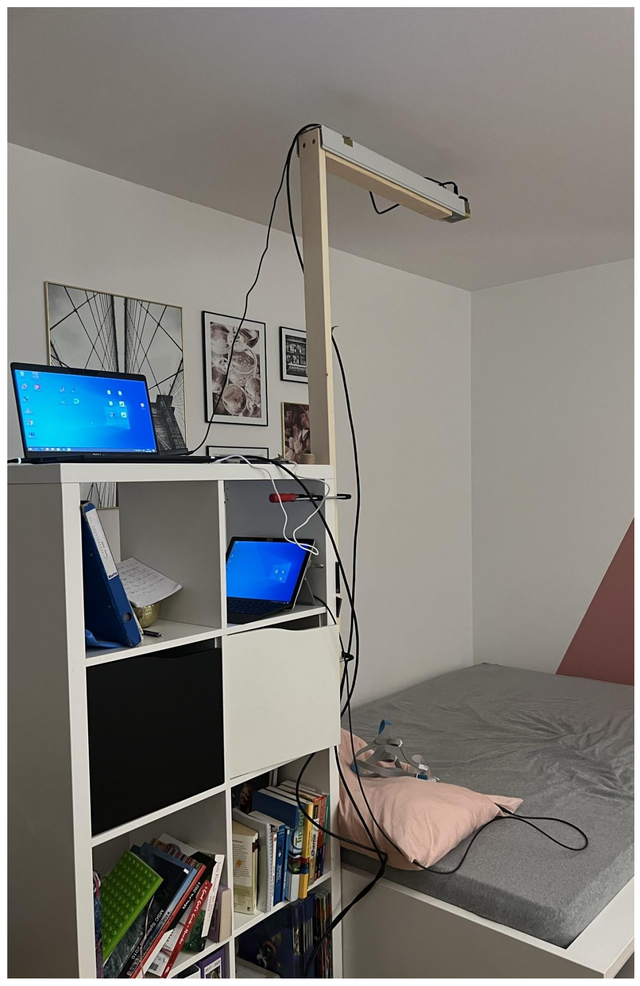
HSLU Hochschule Luzern

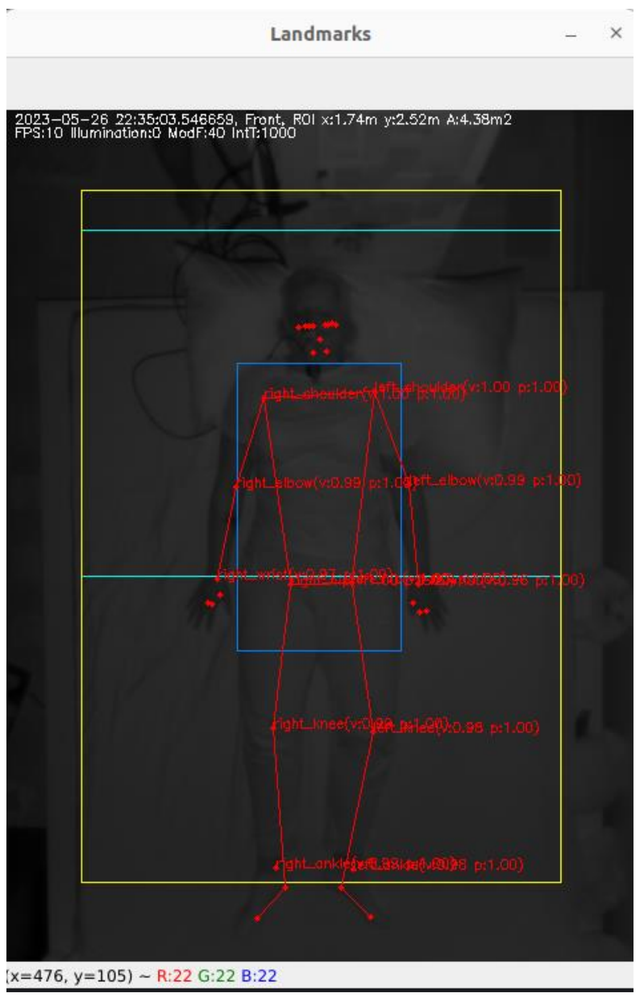
Technik & Architektur

Bachelor-Thesis Medizintechnik

Medizintechnik

Sleep Analysis using 3D-ToF System





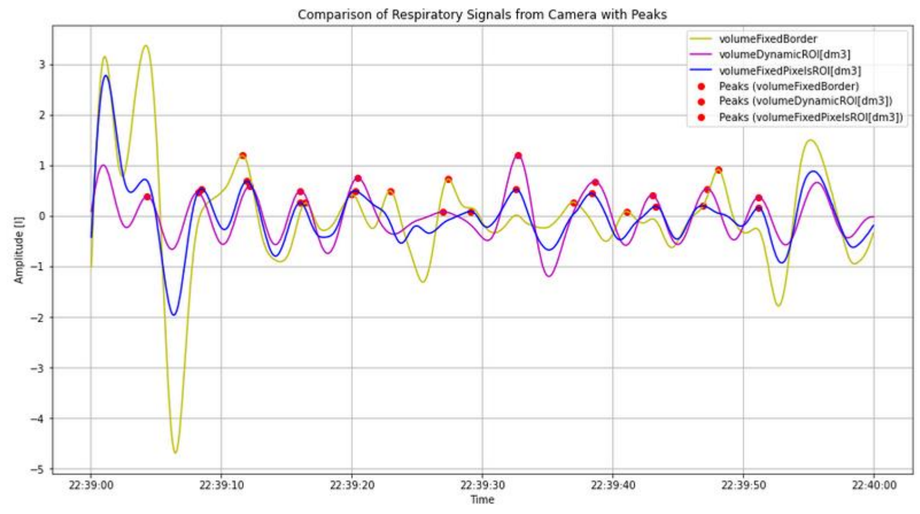

```
desired_start_time = pd.to_datetime("2023-05-26 22:35:10.000000", format='%Y-%m-%d %H:%M:%S.%f')
desired_end_time = pd.to_datetime("2023-05-26 22:36:10.000000", format='%Y-%m-%d %H:%M:%S.%f')

dataframe_camera = pd.read_csv("Aufnahme3_Kamera.csv", on_bad_lines='skip', usecols=[0, 3, 4, 5])
dataframe_camera['timeUTC'] = pd.to_datetime(dataframe_camera['timeUTC'])
dataframe_camera.set_index('timeUTC', inplace=True)

# Extract the three respiratory signals for the desired time range
rsp1 = dataframe_camera.loc[desired_start_time:desired_end_time, 'volumeFixedBorder[dm3]']
rsp2 = dataframe_camera.loc[desired_start_time:desired_end_time, 'volumeDynamicROI[dm3]']
rsp3 = dataframe_camera.loc[desired_start_time:desired_end_time, 'volumeFixedPixelsROI[dm3]']

# Clean the three respiratory signals
cleaned_rsp1 = nk.rsp_clean(rsp1, sampling_rate=20, method="biosppy")
cleaned_rsp2 = nk.rsp_clean(rsp2, sampling_rate=20, method="biosppy")
cleaned_rsp3 = nk.rsp_clean(rsp3, sampling_rate=20, method="biosppy")


# Peak detection, low-level function used by rsp_peaks() to correct the peaks found by rsp_findpeaks()
info_1 = nk.rsp_findpeaks(cleaned_rsp1, sampling_rate=20)
info_1 = nk.rsp_fixpeaks(info_1)
info_2 = nk.rsp_findpeaks(cleaned_rsp2, sampling_rate=20)
```



Objective

The iHomeLab has developed a sleep monitoring system for the home sleep lab that can contactlessly and conveniently measures the breathing volume and movements of a sleeping person via a 3D camera system. A key goal of the iHomeLab system is to provide a sleep monitoring system that minimizes the sleep behavior as little as possible through sensors and wiring.

The main objective was to assess the volume measurement capabilities of the currently available iHomeLab system in conjunction with the Basler camera. In addition, various sensors were tested for a planned reference measurement campaign and based on the measurements done, a sleep apnea detection code was developed.

Solution

Several measurements were made with the 3D-ToF camera with a test person on the back without a blanket. In addition, an airflow mask was worn for this purpose. The results of the camera were compared with an airflow mask. The sensors for the measurement campaign were tested over several nights. Any shortcomings were corrected or noted to guarantee a successful measurement campaign.

Results

It had to been done modifications to the code for operating the camera and processing the signals. Valid signals were obtained, but the derived tidal volume showed excessively high values. The blaze-101 camera had different specifications, leading to discrepancies. A new algorithm was developed for detecting sleep apnea events based on peak analysis, This code has to be further improved to minimize effects of signal noise and increase overall robustness.

The reference campaign was prepared in detail, and the sensors were tested. Some sensors were not working as expected. However, these could be replaced or fixed. Some sensors have peculiarities which were noted. The 3D-ToF camera still possess problems with processing time and resource usage, which should be reconsidered before starting a full measurement campaign with whole night measurements.

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