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TECHNISCHE UNIVERSITÄT ILMENAU

Fakultät für Maschinenbau

**Fachgebiet Qualitätssicherung und Industrielle Bildverarbeitung**

Task Description for the Project Seminar or Master Thesis

of N. N.

Comparative Study of Open-Source rPPG and Camera-based Vital Signs Estimation Toolkits and Datasets

General Description:

Non-contact measurements methods are expected to expand the application scenarios of vital signs moni-toring with better hygiene and comfort. Many studies have validated the feasibility of camera-based contactless measur-ements for some vital signs, including heart rate (HR) [1], respiration rate (RR) [2], body temperature (BT) [3], and oxygen saturation (SpO2) [4]. Previous studies in TU Ilmenau QBV introduced a 3D multimodal (RGB, 3D, NIR, thermography) camera system and a series of data processing and vital signs estimation algorithms, which allow simultaneous monitoring of multiple vital signs [5]. To quantitatively demonstrate the advantages and transferabilitz of our approach, a systematic discussion on benchmark approaches and datasets is expected.
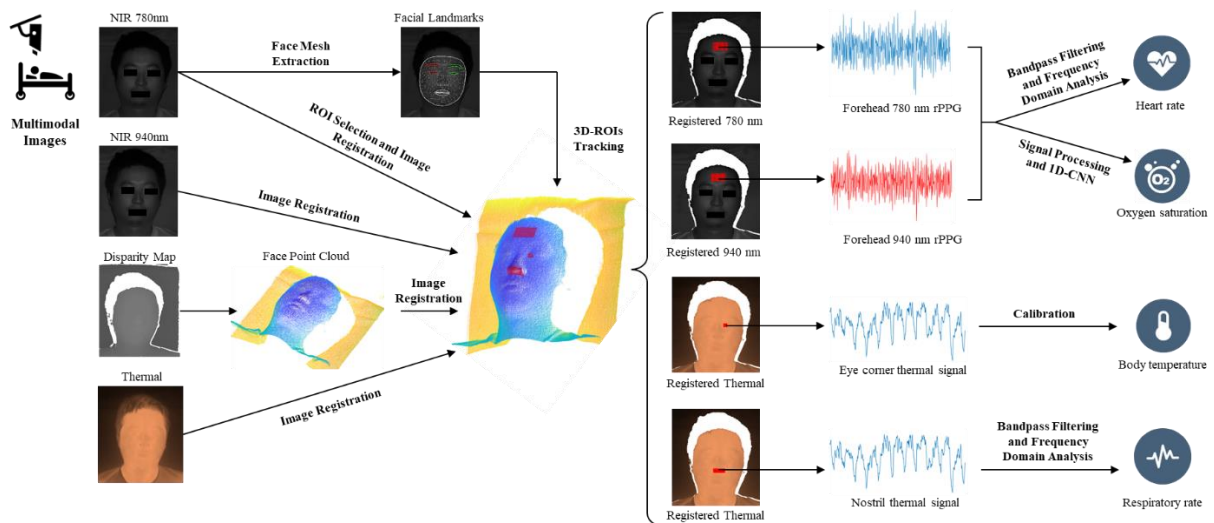
Task:

Many open-source toolkits offer solutions for vital signs estimation especially heart rate, heart rate varia-tion and respiration rate, which have also been validated on benchmark datasets. In this work, methods from various open-source toolkits are expected to be systematically compared across different datasets. Among these, the better-performing methods will be tailored to our dataset NEON (3D VIS-NIR multi-modal data) for further validation and discussed as a baseline against by our developed algorithms.

In the context of this work, the following tasks arise in particular:

- Literature research on camera-based vital signs estimation (rPPG, heart rate, heart rate variation, oxygen saturation, respiration rate).
- Implementation and reproduction of different open source analytical rPPG and vital signs processing methods and machine learning / deep learning toolkits (Python, Pytorch, Matlab)
- Comparison and validation of the performance of different tools in diverse open-source datasets as well as our NEON dataset based on selected evaluation metrics.
- Documentation and presentation

1. Svoboda, Libor, et al. "Contactless heart rate measurement in newborn infants using a multimodal 3D camera system." Frontiers in Pediatrics 10 (2022): 897961.
2. Karlen, Walter, et al. "Estimation of respiratory rate from photoplethysmographic imaging videos compared to pulse oximetry." IEEE journal of biomedical and health informatics 19.4 (2015): 1331-1338.
3. Lin, Jia-Wei, Ming-Hung Lu, and Yuan-Hsiang Lin. "A thermal camera based continuous body temperature measurement system." Proceedings of the IEEE/CVF international conference on computer vision workshops. 2019.
4. Liao, Wang, et al. "Oxygen saturation estimation from near-infrared multispectral video data using 3D convolutional residual networks." Multimodal Sensing and Artificial Intelligence: Technologies and Applications III. Vol. 12621. SPIE, 2023.
5. Zhang, Chen, et al. "Real-time multimodal 3D imaging system for remote estimation of vital signs." Multimodal Sensing and Artificial Intelligence: Technologies and Applications II. Vol. 11785. SPIE, 2021.

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Responsible professor:	Univ.-Prof. Dr. rer. nat. Gunther Notni
Advisor:	M. Sc. Wang Liao / M. Sc. Chen Zhang
	wang.liao@tu-ilmenau.de
	chen.zhang@tu-ilmenau.de