A Survey-Cardiovascular Signal Rate Detection

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***Abstract*: Heart Rate (HR) is one of the most important Physiological parameter and a vital indicator of people's physiological state and is therefore important to monitor. Monitoring of HR often involves high costs and complex application of sensors and sensor systems. This project deals with the diagnosis of heart problems by computing the heart rate measurements from video images of the human face recorded using a simple webcam. Here, the main idea is to extract HR from the color variation in the facial skin due to cardiac pulse and the implementation has been done using a simple webcam in indoor environment with constant ambient light. In this paper Viola and Jones algorithm has been employed for this purpose which is based on Haar-like rectangular features that are extracted from integral images. The regions detected by the Viola and Jones detector cannot be directly used in our system, as it contains the areas of eyes and the mouth which are not good for the purposes of our system therefore forehead region is selected. Empirical mode decomposition is performed for reflectance decomposition of the forehead region**

***Keywords*: viola jones algorithm, haar-like rectangular feature, empirical mode decomposition, reflectance decomposition.**

1. Introduction

Heart rate is one of the essential parameters in most of the medical diagnosis techniques for numerous medical conditions. Earlier detection of heart rate involved counting of heart pulse by either holding the person's hand or by attaching a machine having a heart rate sensor to person's body part over a vein. In previous few years numerous systems have emerged. Heart rate is directly proportional to the need to absorb oxygen by the body, and thus it is constantly checked by medical professionals. It is defined as the number of times that the heart contracts in a unit of time, usually expressed in beats per minute (bpm). This value differs for activities such as sleeping or exercising. Additionally, the heart rate is an indicator of the fitness levels of a person, hence the interest of several athletes in monitoring it, in order to maximize the efficiency in their training. A high growing percent of deaths worldwide are related to cardiovascular disease, including sudden cardiac death, hypertension, hemorrhagic shock and septic shock. Heart rate monitors are simple inexpensive tools that can detect potentially life- threatening arrhythmias or heart rhythm malfunctions. In our proposed framework, the decomposed face reflectance, rather than the illumination part, is used for heart rate evaluation since, as blood volume in the blood vessels in the face expands with every heartbeat, the reflectance strength shown by the face will vary with hemoglobin absorptive across the visible light spectrum. we first decompose reflectance from the green channel and then decompose intrinsic mode functions (IMF) using ensemble empirical mode decomposition (EEMD) to separate the effect component that represents the real heart rate variation from environmental noise. The details of the proposed framework are described. Finally, some concluding remarks are drawn. An image covering the subject's brow area is first captured and then the green channel is selected for reflectance decomposition since oxygenated hemoglobin absorbs green light. The variation of oxygen levels in blood can thus be modeled as the reflectance strength of the green channel. The method for reflectance decomposition is presented. The reflectance strength alters with every heartbeat. However, this time signal is too noisy to identify each heartbeat period. Then finally the values obtained from EMD is compared with the standard heart rate to obtain the individuals heart rate

2. Literature survey

Li et. al. (2014) [3] suggested to first detect face landmarks and then perform tracking. They used the background to perform illumination rectification on the face. For non-rigid motion due to facial emotion, they used a heuristic to cut portions of the illumination corrected traces that corresponded to sudden shifts in facial emotion. They essentially works by using tracking to overcome rigid motion, using illumination changes in the background to rectify illumination changes on the face, and cropping out "noisy segments" from their estimated plethysmograph (PG) signals that were caused by non-rigid motion (e.g. displays of emotion on the face). While highly effective in some settings, their method has some drawbacks. The background's appearance changes over time cannot always be used to cancel out the effects of illumination change on skin. This is because the spectral reflectance of the background and skin are likely to be different. In addition, complex backgrounds (e.g. outdoors) would make such illumination rectification unreliable. Cutting out time segments that exhibit changes in emotion is also less than ideal as portions of the final estimated PG signal would be missing.

Poh et. al. (2011) [7] suggested to clean up the traces and make determining the HR more accurate. In addition, they chose to test their method on the publicly available MAHNOB-HCI Database, which allows for more fair comparisons. While effective, their method has some drawbacks. Their illumination rectification step uses illumination changes in the background as an approximation to how the illumination changes would affect the face's appearance. However, the spectral reflectance of various surface points in the background would likely be different from the skin's spectral reflectance. This means that even the same illumination would affect the appearance of the face and background differently. In addition, outside of an HCI setting, the illumination in the background could be completely different from the illumination on the face. Another issue is that non-rigid motion is dealt with by essentially clipping out time segments. This means that cardiac activity in those video segments would be thrown out. Also, for shorter videos, pruning parts of the trace may not be an option.

Kumar et al (2015) [2] suggested to extracts the PG signal under challenging conditions. We consider some of their ideas complementary to ours. They used a "goodness metric" to adaptively determine a weighted average of band pass filtered green channel traces from preset face sub regions. This average was then considered the PG signal. Their formulation requires illumination to be fixed over the time window of interest. We estimate the PG signal from dynamically chosen subregions in a BSS formulation, which allows for varied lighting over time in terms of both color and brightness. They also did not use the MAHNOB-HCI Database but will be sharing their own dataset soon.

Verkruysse et al (2008) [9] suggested that remote PPG could be done using just a conventional camera (Canon Powershot) and normal ambient light in the visible spectrum (daylight and normal office fluorescent lighting). They showed that the green channel of a conventional camera provided the strongest PG signal since hemoglobin light absorption is most sensitive to oxygenation changes for green light. In addition, the red and blue channels also contained some PG information.

Wu et al (2012) [5] suggested impressive visualizations of such color changes through magnification. However, these works do not address hindrances to HR estimation such as arbitrary motion and lighting changes that can occur in everyday settings.

Balakrishnan et al (2013) [4] exploits this physiological event to extract heart rate and heart rate variability (HRV) [3]. They extracted motion due to the influx of blood to the head region and then separated out heart rate by monitoring the transients of motion along the principal components of the head's trajectories [3].Android and iOS devices have been used as a platform for many developers to gain quick and easy access to visual sensor information. ViTrox Technologies has developed an iOS app thatis similar to the McDuff et al. implementation.

Krishna et al (2017) [1] measuring HR from facial recordings gained in a more reasonable condition than current frameworks trying surroundings. The proposed strategy utilizes a facial component point-following technique that consolidates a decent element to track technique with an administered plummet technique to conquer the constraints of right now accessible facial video-based heartbeat rate measuring frameworks, including unlikely limitation of the subject's development and counterfeit lighting information catch. A face quality evaluation framework is additionally consolidated to naturally dispose of low quality faces that happen in a practical video grouping to lessen wrong outcomes. The proposed strategy was thoroughly tried on the freely accessible by using PCA (Principle component analysis) algorithm with different techniques and the creators nearby dataset. Test comes about demonstrate that the proposed framework beats existing manual-based frameworks for heartbeat rate estimation.

Obeid et al, in which the person is subjected to a series of low-power electromagnetic pulses [6]. The reflected waves from the chest cavity are received and then processed using the well-known principle of the Doppler effect, which helps determine which direction and how fast an object was moving. In this case, the objects moving are the breathing lungs and the beating heart.

Another validated but vastly different approach is to use thermal imaging in order to detect small changes in skin temperature due to heart beat as demonstrated by Yang et al. [8]. One great advantage of this idea is that ROI selection is relatively simple. The skin, which stands out due to the black-body radiation, stands out from the environment, providing its own video segmentation. While the convenience of this method is promising, the technology is not financially and, in some cases, not physically feasible. These methods, due to cost and physical constraints, are only usable in very narrow fields.

3. Conclusion

In this paper, the focus is to implement a heart rate estimator based on facial video recorded using webcam using MATLAB. The conclusion of this paper provides heart rate measurements using empirical mode decomposition of Hilbert's Huang's transform more accurately.

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