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Patient Monitoring System Using Image Processing

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ABSTRACT: Respiratory disease is a medical term which affects the organs and tissues which allows gas exchange possible in organism and includes condition of the respiratory tract. Heart rate is the speed of heartbeat measured by the number of contraction of the heart per minute (bpm).According to the physical body of a human being, the heart rate may vary person to person. One of the respiratory disease called severe acute respiratory syndrome(SARS) which spreads around the world in 2003.Therefore many of the quarantine station were affected and a system is launched to detect infected passengers. A method for non contact measurement of multiple vital signs i.e respiratory rate and heart rate based on RGB image processing with CMOS camera is proposed. Monitoring the periodic temperature changes of RGB images at nasal area can calculate respiratory rate. Heart rate is measured by capturing the brightness variations of RGB facial images by fluctuations in skin blood flow. The transmission of disease can be prevented by this non contactable method.

KEYWORDS: CMOS camera; image processing; non contact.

I. INTRODUCTION

Respiratory disease is a medical term which affects the organs in higher organisms.It includes condition of the upper respiratory tract, trachea, bronchi, bronchioles, alveoli, pleura and pleural cavity.Heart rate is the speed of heartbeat measured by the number of contractions of the heart per minute (bpm).According to the body's physical needs ,the heart rate may vary person to person .One of the respiratory disease known as severe acute respiratory syndrome is caused by coronavirus.An outbreak of SARS in southern china caused an eventual death resulting in 774 deaths during the year of November 2002 and july 2003.No cases of SARS have been reported worldwise since 2004.There is no treatment for SARS which is safe for humans as per 2015.The identification and development of novel vaccines and medicines to treat SARS ia a priority for government and public health agencies aroud the world.Some of the international airports adopted the method of screening using thermography.

II LITERATURE REVIEW

The author [1] proposes a system screening of infected individuals by using thermography.This non-contact method was assumed to be essential in preventing and controlling the transmission of diseases. Infrared cameras working in the range of long wave infrared region from 8 to 14 µm are used in fever screening. An algorithm to automatically detect human subjects with fever in infrared images is presented in this paper. The algorithm was tested on a training data population to obtain a decision threshold in the framework of Neyman-Pearson hypothesis testing. Results show a high detection frequency. The algorithm is illustrated by testing it with simulated images and with images acquired by an infrared camera system. Several relevant scenarios involving different radiating objects in the field of the camera were reproduced and tested

In [2] the research work is to measure different parameters that are heart rate, respiratory rate, BP using photoplethysmographic sensors .PPG signal is acquired by PPG sensor, microcontrollerThe acquired PPG signal is displayed in MATLAB. Frequency domain analysis of PPG signal shows two peaks first at around 0.25 to 0.35 Hz and second at around 1 to 1.5 Hz. FFT at 1Hz relates to 60 BPM and FFT at 0.25 Hz relates to 15 respiratory cycles per minute. For BP Measurement, the pulse height of PPG is proportional to the difference between the systolic and the diastolic pressure in the arteries. The standard blood pressure monitoring instrument is used to calculate correlation

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coefficient. The arterial blood pressure is calculated based on these coefficients. PPG signal is used to detect blood pressure pulsations in a finger and achieved an accuracy of (0.8 ± 7) mmHg and (0.9 ± 6) mmHg for systolic and diastolic pressure, respectively.

In [3] the author developed a CMOS Doppler radar sensor which is used to measure motion due to heart and respiration. A CMOS Doppler radar sensor has been developed to measure heart rate and respiratory rate. The quadrature direct-conversion radar transceiver has been fully integrated in 0.25-mum CMOS, the baseband analog signal conditioning has been developed on a printed circuit board, and digital signal processing has been performed in Matlab. The signal-to-noise ratio (SNR) is derived based on the radar equation, the direct-conversion receiver's properties, oscillator phase noise, range correlation, and receiver noise.Severe acute respiratory syndrome was first reported in 2003 and very quickly it spreads.Therefore many international airports adopted this technique to detect heart and respiratory disease.Heart rate and respiratory disease can be detected by using thermal and RGB images by using a CMOS IR camera.In this proposed work, a image processing is conducted on thermal and RGB image in a real time .The respiratory rate is determined by the thermal images of the IR camera and heart rate is determined by the RGB images of the CMOS IR camera.Also by the capturing the brightness variation of RGB facial images ,heart rate can be detected.

In [4] The outbreak of infectious diseases such as influenza, dengue fever, and severe acute respiratory syndrome (SARS) are threatening the global health. Especially, developing countries in the South-East Asia region have been at serious risk. Rapid and highly reliable screening of infection is urgently needed during the epidemic season at mass gathering places, such as airport quarantine facilities, public health centers, and hospital outpatients units, etc. To meet this need, our research group is currently developing a multiple vital-signs based infection screening system that can perform human medical inspections within 15 seconds. This system remotely monitors facial temperature, heart and respiration rates using a thermopile array and a 24-GHz microwave radar, respectively. In this work, we redesigned our previous system to make a higher performance with a user-friendly interface. Moreover, the system newly included a multivariable logistic regression model (MLRM) to determine the possibility of infection. We tested the system on 34 seasonal influenza patients and 35 normal control subjects at the Japan Self-Defense Forces Central Hospital. The sensitivity and specificity of the screening system using the MLRM were 85.3% and 88.6%, respectively.

In [5] author describes the the outbreak of severe acute respiratory syndrome (SARS) in 2003, many international airport quarantine stations conducted fever-based screening to identify infected passengers using infrared thermography for preventing global pandemics. Due to environmental factors affecting measurement of facial skin temperature with thermography, some previous studies revealed the limits of authenticity in detecting infectious symptoms. In order to implement more strict entry screening in the epidemic seasons of emerging infectious diseases, we developed an infection screening system for airport quarantines using multi-parameter vital signs. This system can automatically detect infected individuals within several tens of seconds by a neural-network-based discriminant function using measured vital signs, i.e., heart rate obtained by a reflective photo sensor, respiration rate determined by a 10-GHz non-contact respiration radar, and the ear temperature monitored by a thermography. In this paper, to reduce the environmental effects on thermography measurement, we adopted the ear temperature as a new screening indicator instead of facial skin. We tested the system on 13 influenza patients and 33 normal subjects. The sensitivity of the infection screening system in detecting influenza were 92.3%, which was higher than the sensitivity reported in our previous paper (88.0%) with average facial skin temperature.

In [6] author describes about the Microfluidic analytical devices that can be used in preliminary screening and diagnosis of specific diseases. The main advantages of this method are that it is low costs and quick diagnosis. The paper chip will display the disease's relative status through color identification or electrochemistry testing after doing chemical reaction. When compared to electrochemistry testing, the non-contact color identification method has the advantages of low costs, reusability and not requiring cleaning. However since research in the past have encountered many problems with the color identification method, this has led to the negation of the advantages of microfluidic paper-based analytical devices in quick testing. For this reason, this study developed a portable testing apparatus with image analysis as a foundation and uses a self-designed imaging processing calculation method to implement color identification. The hardware equipment designed for image processing uses a micro embedded style system and imaging equipment as the hardware framework, along with a Web application to implement a multi-platform operating interface. To calculate paper chip's colour, color quantization was used as the foundation for the image processing method. Furthermore, to compare the colourquantization, this study also carried out a variety of color quantization methods. Methods include uniform color quantization, median-cut algorithm, k-means clustering algorithm and self-organizing maps neural networks. During the

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experiment phase of this study, we found that median-cut was superior to other methods in application. This result is different from many other research works conducted on color quantization. Lastly, the experiment results showed the usability of this testing setup.

In paper [7] author present a simple, low-cost method for measuring multiple physiological parameters using a basic webcam. Independent component analysis is applied on the color channels in video recordings;the blood volume pulse is extracted from the facial regions. Heart rate (HR), respiratory rate, and HR variability (HRV, an index for cardiac autonomic activity) were subsequently quantified and compared to corresponding measurements using Food and Drug Administration-approved sensors. High degrees of agreement were achieved between the measurements across all physiological parameters. This technology is beneficial for advancing personal health care and telemedicine

III. PROPOSED SYSTEM

The method is divided into two different section .First is to find out the respiratory rate using RGB image and second is to find heart rate using RGB image.

Based on RGB image processing, we propose a method for non-contact measurement of multiple vital signs, i.e., facial skin temperature and respiratory and heart rates, with a CMOS camera .Respiratory rate is calculated by monitoring the periodic temperature changes of thermal images at nasal area.And by capturing the brightness variations of RGB facial images caused by fluctuations in skin, heart rate is calculated.A CMOS camera is used to evaluate the efficiency of heart rate and respiratory rate.We tested themeasurement of respiratory and heart rates on ten male subjectsunder resting and after exercise conditions with ergometer.We will compare the respiratory rate and heart rate by contact type method in 10 secs.This metod can applied in hospitals, airport, station where the chances of getting infection from other people is possible.Hence the risk of infection can be decreased.

The RGB images were acquired and analyzed inPython using OpencV in real time. In Fig. 1the method tocalculatethe respiratory and heart rates is shown. The TVS-500EXLV is used as a CMOS IR camera that integrates sensor camera and IR camera,and also it provides thermal and RGB fusion mode.The ratio of overlapped thermal and RGB images is adjustable. The thermal/RGB mixed-images were obtained at 30 frames per sec with a 640 × 480 pixelsolution; a camera will capture the image of a person using CMOS camera and each image is send to PC.

We focused on the first images to calculate respiratory rate shown in Fig 1.Then set the region of interest (ROI) and it should be centre of person nasal area approaximately 150 × 150 pixels.The region of interest is taken as nose to calculate repiratory rate because usually the respiratory process i.e inhaling and exhaling is done through nose.The temperature in the ROI will vary with breathing process of a person.Therefore, each pixel value of red, green, and blue planes of thermal image in the ROI shows the variation along with breathing.Then the differences in pixel values of red, green, and blue planes of each thermal image is calculated. Subsequently, the respiratory waveform was created from the differences of RGB values on each ROI image in a time series (Fig. 1). Each difference of RGB pixel value was calculated by subtracting the RGB pixel values of an image from the values of the next frame. The waveform is then transmitted to the signal processing unit. After the wavefom is created, a band pass filter(0.17-0.42Hz) is used to attenuates frequencies which decreases the noise in further processing step.The DFT(Discrete Fourier Transform) is used for converting the signal from the time domain to the frequency domain. Since DFT is a difficult process we use FFT (Fast Fourier Transform) to save processing time.The highest peak is found after calculating the FFT. It is then translated to the corresponding frequency in FFT vector.The heart rate and respiratory rate is calculated from the time between any two QRS complexes of a waveform.

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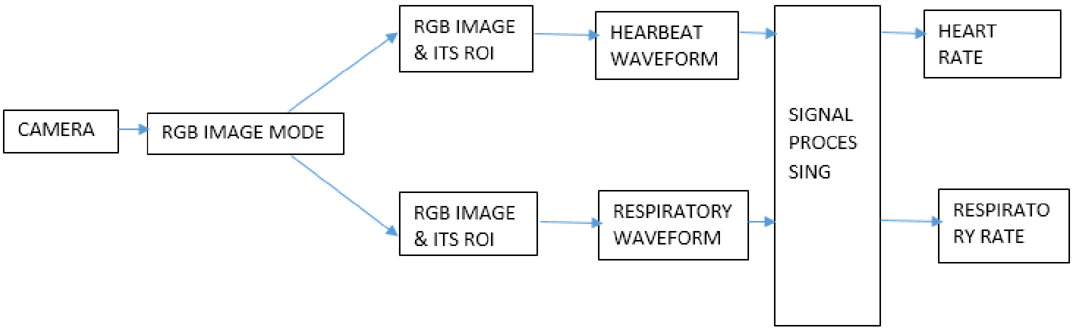

Figure 1. Block Diagram of a System

To calculate the heart rates,the first image of RGB-predominant images is used.The ROI (pixel solution wasapproximately 150 × 180 pixels)is set as to be the center of thesubject's face. All images were obtained as those of configuring by only the green plane signals; we calculated the mean brightness value of each image as follows CMOS CameraWe used the obtained mean brightness value to create thewaveform. The heart rates were calculated in thesame analysis program with respiratory rates, except for thesetting of the band-pass filter (0.83–2.0 Hz). The underlyingsignal of interest is a blood volume pulse that propagatesthroughout the body. During the cardiac cycle, volumetricchanges in the facial blood vessels modify the amount ofambient light absorption according to subsequent changes inthe amount of reflected light. These changes indicate the timingof cardiovascular events. By shooting a video of the facialregion with a CMOS camera, the red, green, and blue colorsensors pick up a mixture of the reflected plethysmographicsignals, including other sources of fluctuations in light due toartifacts. We adopted the green signal, which is the mostsuitable color for calculating the heart rate. By capturingthe tiny changes of the green signal, we successfully calculatedthe heart rate.

IV. DISCUSSION AND CONCLUSION

To evaluate the performance and analyse algorithm, the literature survey is done and the the best method is found to calculate the heart rate and respiratory rate.This method enables screening the vital signs i.e respiratory rate and heart rate based on RGB image processing with CMOS camera, indicating that there is no need of equipment or measuring hardware. Furthermore, thismethod requires no contact with machines, resulting inreduction of secondary infection. The expected result shows the feasibility of noncontact measurement of vital signs using a CMOS camera for prompt infection screening at airport stations.

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