Development and Evaluation on The Framework Design of a Continuous Mental Stress Monitor Based on Contactless Sensors and Internet Technology Applications

Manhai Li, Xunyi Zheng*

School of Media and Arts, Chongqing University of Posts and Telecommunications, China
limh@cqupt.edu.cn, 1622671322@qq.com

Abstract

Due to the impact of COVID-19 pandemic, there are quite a few concerns on organizations or companies with the capability in quickly and timely detecting psychological vulnerability level of employees and predicting potential risk behaviors. Regarding the application of daily health monitoring, ordinary camera is used to non-contact capture the shallow blood changes under the face, using algorithm to identify the physiological signs of human body, such as blood oxygen, blood pressure, respiration, and heart rate. With the rapid advancement of Internet technology, it not only assists the corresponding model of physiological signs and psychological symptoms on mapping the change regularities and health score of people's psychological state at any time, but also utilizes suitable Internet technologies to realize and provide early warning and intervention too. The experimental results of this study show that the constant non-contact detection of human psycho-logical vulnerability level is theoretically feasible and that it can provide practical and effective reference for psychological health assessment. As a result, the scheme of epidemic psychological prevention adopted in this research has the convenience of rapid detection and real-time prediction as well as the scientific of long-time big data tracking and backtracking through the application of Internet technologies, which is a supplement to the traditional psychological detection and prevention.

Keywords: Contactless monitoring, Continuous tracking, Psychological stress, Rapid detection, Face video analysis

1 Introduction

1.1 Mental Stress Maters

Mental stress is used to describe experiences that are challenging emotionally and physiologically. Good stress, in popular jargon, generally refers to those experiences that are of limited duration and that a person can master, and which leave a sense of exhilaration and accomplishment whereas bad stress or being stressed out, in the vernacular, refers to experiences where a sense of control and mastery is lacking and which are often prolonged or recurrent, irritating, emotionally draining, and physically exhausting or dangerous [1].

In modern society, people often bear the pressure of work, life, economy, inter-personal relationships and so on. The brain is the key organ of the response to stress because it determines what is threatening. Potentially stress can lead to adaptive or disruptive physical and behavioral responses, such as facial acne, weekend headaches, mouth soreness, bleeding gums, itchy skin, and other symptoms. Continuous stress will bring psychological and physical obstacles, which will make people sick [2]. According to a statistical data of Chinese Center for Disease Control and Prevention (CCDCP) in 2009, the number of patients with various mental diseases in China was more than 100 million, and the number of serious mental patients had exceeded 16million.

Mental stress has already become a serious social problem, which has been more deteriorating especially affected by the COVID-19. Affected by the COVID-19, people generally show anxiety, depression, panic, and anxiety. The National Health Commission of the Peoples Republic of China issued the guiding principles for emergency psycho-logical crisis intervention in the epidemic of COVID-19 infection with pneumonia for the first time, incorporating psychological crisis intervention into the over-all deployment of epidemic prevention and control.

1.2 Dilemma in Traditional Mental Stress Detection

Psychological counseling refers to the process of using psychological methods to provide psychological assistance to those who have problems with psychological adaptation. It is necessary to quickly screen out serious patients and give psychological health counseling at the first time. However, for a long time, people have carried out mental stress detection through interviews and psychological questionnaires. This interview method employed by the study is generally referring to the communication between the psychological counselor and the visitor through language and other media, to discuss and find out the cause of psychological problems, analyze the crux of the problem, and then seek the conditions and countermeasures to get rid of the predicament and finally to solve the problem. In relation to above problem solving, questionnaire methods are often used in the clinical

*Corresponding Author: Manhai Li; E-mail: limh@cqupt.edu.cn
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practice of psychology and psychiatry too. Among them, the representative questionnaire methods mainly include LECI (Life Event Resolution Questionnaire), PSS (Perceived Stress Scale) and SRI (Stress Response Questionnaire). Principally, PSS studies what happened in last month as the study period of questionnaires, so as to quantify the stress level of subjects facing unpredictable events. The SRI assessment of the subjects' stress level is implemented through seven emotional states including somatization, frustration, and depression. The LECI is essentially used to assess the level of stress of how children dealing with their daily life events.

However, there are disadvantages of such traditional method such as it requires experts to provide counseling and interpret the psychological questionnaire. Since experts can only provide services to one patient at a time, a limited number of experts can only solve the problems of a certain number of patients. Furthermore, without specific preparation by experts, this method may not be fully implemented. For example, due to patients are aware of they are in the process of evaluation by receiving an interview or answering the questionnaire, patients may deliberately choose the wrong answers or avoid questions resulting in inaccurate evaluation results.

In fact, there remain various factors leading to mental stress, and the relationship between them is complex. Consequently, only through a period of real-time observation can accurate and scientific judgments be made, rather than merely relying on answering questionnaire for evaluation or seeking consultation that are not comprehensive enough.

2 New Approaches of the Design for Mental Stress Detection

2.1 Using Contact Sensors to Get Physiological Characteristics

In general, sensors are regarded as devices used to detect and respond to certain indicators from the physical. environment. The objects it monitors can be mechanical equipment, vehicles, or human physiological indicators. The input signals include light, heat, movement, moisture, and pressure, etc. The signals output by the sensor are converted into readable and visible information for further processing for the proposed evaluation. With the development of related technologies, automated detection technology and equipment began to be applied to psychological stress detection. The usual approach is to install sensors that can detect physiological data such as heartbeat and blood pressure into bracelets. When people wear such bracelets, these sensors can transmit physiological data to the service platform and obtain the evaluation results of psychological stress through data analysis via Internet. In China, several companies provide such health detection solutions, such as Xiaomi, Huawei and etc. in China. Not only this method can monitor on the real-time changes of people's daily psychological stress, but also can provide psychological early warning and guidance in time.

However, contact sensors are used on the premise that the users are willing to wear these sensors. For example, the elderly who are in poor health hope to inform doctors and family members as soon as possible when having sudden myocardial infarctions, so they voluntarily wear heart rate detection sensors. If some people feel bad about being monitored and are unwilling to take the initiative of wearing detection sensors, and that there are also peoples who may be affected by the psychological state when wearing these sensors, such as generating some unnecessary psychological hints or psychological anxiety, etc., these conditions will in turn affect the state of the person, thereby affecting the accuracy of the data test. Ultimately, these sensors are unable to function properly and transmit accurate and useful data.

2.2 Using Contact Sensors to Get Physiological Characteristics

It is undoubted that contact sensors must be in contact with the human body to have signals, on the contrary, contactless sensors can detect changes in electromagnetic fields or light within a specific range. Contactless sensors can generate signals without contacting the human body, such as cameras, infrared sensors, laser sensors, etc. For instance, people's facial expressions can be captured non-contact through the camera. Contactless sensors are characterized by their suitability for continuous and rapid measurements. A long service life is also a feature of non-contact sensors, they are wear-free and extremely resistant to external influences. This makes them display impressive longevity, precision, and resolution. In the recent period of social events on preventing and controlling the COVID-19, contactless temperature control sensors have been widely used, which not only improves the efficiency of measuring human body temperature, but also reduces potential risks of virus transmission.

Nowadays, the detection of mental stress by contactless sensors has become a research hotspot. People do not need to wear wearable devices, without disturbing their normal work and life, the sensors senselessly collect people's relevant physiological indicators, and then track their psychological pressure by analyzing these data.

2.3 Interpreting Physiological Characteristics to Mental Stress

No matter which detection method is adopted, whether mental stress can be accurately interpreted from physiological big data is the key. However, there is no mature pro-gram recognized by the industry that can accurately assess the level of mental stress. Therefore, it is necessary to conduct research in this area.

When people are under great psychological pressure, their physiological characteristics will change or fluctuate, which has been verified by a large number of studies. Physiological equilibriums disrupted when people experiencing stress, the resistance of the body changes, and many physiological parameters are also affected. Therefore, the use of physiological parameters to evaluate the degree of stress has been affirmed by relevant scholars. At present, many scholars use physiological signals such as EEG, EMG, respiratory rate, and ECG to analyze the stress state. Physiological characteristics include heart rate [3], pupil size [4], blood pressure [5], respiratory rhythm [6], galvanic skin response [7], emotional expression [8], pitch of voice [9], and body

posture [10].

Many research results on the relationship between physiological characteristics and psychological stress had been conducted. For example, Kumar et al. established a fuzzy evaluation of heart rate signals for mental stress assessment. Choi et al. studied an ambulatory stress monitor based on wearable sensors, which could evaluate whether people are in a state of stress or relaxation through the data of galvanic skin response, respiratory rhythm, and heart rate variability [11]. Santos et al. constructed a stress-detection system based on physiological signals and fuzzy logic, for example, galvanic skin response and heart rate [12]. Hong Mo Seong carried out the experiment and analysis of mental stress using time-frequency distribution of heart rate variability signal [13]. Lizawati Salahuddin conducted an ultra-short-term analysis of heart rate variability for monitoring mental stress in mobile settings [14]. Vesna Vuksanovi carried out the study on the heart rate variability in mental stress aloud [15].

The above study results show that the change of physiological characteristics is the external manifestation of mental stress. If all physiological characteristics of peoples can be detected and analyzed, then the real situation of mental stress can be traceable in a considerable and comprehensive way.

3 Theoretically: Three Physiological Characteristics

3.1 Taking Heart Rate Variability as a Quantitative Indicator

Heart rate is defined as the number of times of heart beats over a period of time. Studies have shown that when people are in a state of anxiety for a long time and have too much mental pressure, their cardiac nervous function and endocrine hormones will be unbalanced, which could lead to arrhythmia [16]. In general, Heart Rate Variability (HRV) refers to the small difference during successive heart beats, which is an ideal indicator to judge the autonomic nerve function. In 1981, Akselrod et al. proposed to use the power spectrum of heart rate as an evaluation method when appraising the regulatory of the cardiovascular system, which confirmed that HRV is an important factor in predicting death from acute myocardial infarction and revealed the value of HRV frequency domain analysis, which had become the milestone of HRV research. In 1994, the North American Society of Pacing and Electro-physiology and the European Society of Cardiology jointly organized a special committee, which systematically standardized the research and application of HRV, and summarized the correlation between HRV and physiology and pathology, and the current clinical research results. Up to now, a large number of studies have fully proved that HRV contains a lot of information on the regulation of the cardiovascular system and confirmed HRV is the best indicator for the evaluation of the autonomic nervous system. In addition, HRV has a great application value in the field of clinical medicine and public health. Those research results had also confirmed that HRV can be used as one of the clinical indicators for the diagnosis of psychological stress. Yang Huiqin conducted a HRV experiment to 30 patients with anxiety disorder decreased by comparing the HRV time domain parameters with healthy people. Kemp observed 73 patients with depression who were not treated by drugs. Comparing their ECG under short-term rest with healthy peoples, they found these patients with depression had a decrease in HRV [17]. Mateo and other scholars compared and analyzed the measured values of physical anxiety and cognitive anxiety of 11 Spanishes who are National cycling athletes during the stages of pre-competition and morning training [18]. The study results showed that HRV analysis method provides a supplementary way for evaluating competition pressure. To sum up, existing studies have shown that people's psychological stress and mental state can be acquired by observing changes of heart rate.

3.2 Taking Oxygen Saturation of Blood as a Quantitative Indicator

Blood oxygen saturation (SaO2) is the percentage of oxygen-bound oxyhemoglobin (HbO2) capacity in blood to the total bindable hemoglobin (Hb, hemoglobin) capacity. Blood oxygen saturation is an important physiological parameter reflecting the function of breathing and circulation, and it is an index to measure the ability of human blood to carry oxygen. In addition to heart rate, blood pressure, respiratory rate, and body temperature, pulse oximetry is also considered the fifth key health indicator. Monitoring arterial oxygen saturation (SaO2) provides an estimation of lung oxygenation and the oxygen-carrying capacity of hemoglobin. The oxygen saturation of normal human arterial blood is 98% and that of venous blood is 75%. Oxygen saturation of blood is a significant indicator for judging the condition of patients with COVID-19. During the treatment of COVID-19, in addition to the patient's identity and temperature, the patient's oxygen saturation of blood and heart rate are the first-hand information for judging the severity of the disease and, doctors' diagnosis and treatment.

3.3 Taking Blood Pressure Variation as a Quantitative Indicator

Psychological stress can stimulate the body to release a variety of active substances that raise blood pressure, and cause a series of changes in the nervous, endocrine, cardiovascular, immune, and other systems, leading to the continuous rise of blood pressure. Therefore, strengthening blood pressure control in hypertensive patients is crucial. Studies found that hypertensive patients have a stronger response to body stress and are more likely to have negative emotions such as anxiety and depression. These negative emotions will not only increase blood pressure for a long time, but also cause paroxysmal hypertension forming a vicious circle. As early as in 1997, several scholars observed that anxiety panic attacks can lead to sharp fluctuations in blood pressure in patients with essential hypertension in a short period of time, and found that chronic anxiety, anxiety panic attacks and depression are the main factors for resistant hypertension [19]. Scholars such as Alici [20] discussed that even people with normal blood pressure, such as experiencing anxiety and panic attacks, increased the

average blood pressure at night, showing a non-dipper blood pressure change. Qzpelit [21] used the 24-hour ambulatory blood pressure monitoring on 160 patients with essential hypertension. The results showed that compared with patients without anxiety state, the morning peak of systolic blood pressure in patients with anxiety state was significantly higher. Tully et al. [22] assessed anxiety in 1454 elderly people who had been treated with antihypertensive drugs for more than 8 years, and continuously monitored home blood pressure. The results indicated systolic blood pressure increased drastically, along with a significant increase in morning and nighttime systolic blood pressure variability.

4 Practically: The Mental Stress Detection System

4.1 Continuous Detection Method

Most of the professional medical testing detection is based on a variety of physiological indicators, such as skin electricity, respiration, ECG data combination, or the combination of physiological indicators and scales such as: EEG and sleep scale combination. In the actual psychological stress tracking and detection service through the mobile Internet, it is necessary to consider the convenience of physiological index collection, the computational complexity of the detection algorithm, etc. The existing research results obviously cannot meet the application requirements, e.g., the effective collection of EEG and EG data needs to meet specific conditions, and the multi-index detection algorithm will consume more computing resources and energy. Therefore, another goal of this study is how to use a portable physiological index collection device to detect psychological stress with as few indicators as possible, so as to lay a foundation for the practical application of psychological stress tracking and detection. Compared with electrophysiological data such as EEG and EEG, the collection of ECG data has lower requirements on the environment and conditions, and it is easy to obtain the valid data.

To this end, the study jointly developed a patch-type ECG node with Xi'an Jiao tong University, carried out research on the relationship between ECG time-domain indicators and psychological stress, and further explored the use of blood pressure, blood oxygen, heart rate and other indicators to detect psychological stress. Besides, further exploration was carried out to detect psychological stress using indicators such as blood pressure, blood oxygen, and heart rate. The collection of these data can be completed by a face video analysis system based on transdermal optical imaging technology. Photo Plethysmo Graphy employed by the study is normally referring to irradiate the skin surface with light and using photoelectric receivers to receive transmitted or reflected light. Since the blood volume changes periodically under the action of the heart, the light intensity received by the photoelectric receiver also changes accordingly.

Through the change of light intensity, the change information of blood volume and pulse are obtained. (see Figure 1). The traditional photoplethysmography technology mainly applies professional photoelectric sensors in contact with human body to measure the physiological characteristics, while the photoplethysmography technology uses video recording method that has many advantages such as non-invasiveness, non-contact, and wide application range. This technology obtains the time series curve of blood volume change according to the change of pixel gray value of each frame of face video. Then, it is decomposed into a series of Intrinsic Mode Function with different frequency components by using Empirical Mode Decomposition. Finally, through frequency domain analysis, the IMF in the pulse wave frequency range is reconstructed to obtain the PPG signal with low frequency baseline drift and high frequency noise removed. PPG contains important information such as blood flow and heartbeat and it can further obtain physiological parameters such as human heart rate, blood oxygen and blood pressure.

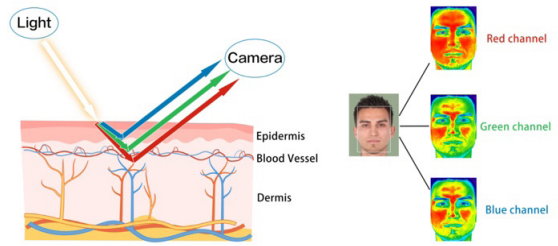

Figure 1. Contactless monitoring method

With the rapid development of computers and the increasingly prominent value of emotional exploration, mining people's inner emotions has become a difficult problem actively explored in the field of artificial intelligence. Nowadays, there are more and more technologies related to emotion recognition, and facial expressions plays a pivotal role in emotional computing. In interpersonal communication, facial expressions have unique advantages in transmitting information compared with language, and the information transmitted is more abundant. There is a mix of emotions during stressful situations, and subjects have the same subconscious facial movements during a given event. In this paper, the micro-expression changes of the human face are captured by ordinary cameras, and the physiological signs such as blood oxygen saturation, respiration, heart rate and so on are identified by artificial intelligence, and then, the changes of people's psychological emotions over a period of time are mapped.

Regularity and health scores are accumulated and presented as Figure 2. However, the shortcomings of traditional psychological testing methods must be improved to a great extent where better results can be obtained.

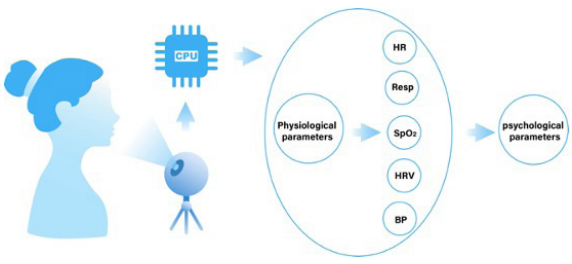

Figure 2. Face video metal stress recognition

4.2 Continuous Tracking Method

In practice, the first step of tracking is to collect the physiological and psychological data of the group, among which those physiological data mostly include heart rate, blood pressure, blood oxygen, etc. And they were obtained through the SCL-90 scale, which is a self-assessment scale of mental health involving a wide range of psychiatric symptoms, from feeling, emotion, thinking, consciousness, behavior to living habits, interpersonal relationships, diet, and sleep. Each of the item is scored on a scale of 1 to 5. Finally, the symptoms are explained according to the scores of participants.

On the basis of the group data, through machine learning and pattern recognition, the corresponding models of different psychological stress conditions and physiological signs are taken. Then, by inputting personal physiological data into the model, the corresponding personal psychological stress status can be derived (see Figure 3). At the same time, with the progress of monitoring, the amount of data in the database will increase. Then, the corresponding model is getting better, and the detection results will be more accurate gradually. At present, this study focuses on the psychological symptoms of the people in different periods of the new coronary pneumonia epidemic, and it mainly explores the following two questions: First, how to continuously monitor and track the people's mental health problems? Second, how to use non-contact methods to obtain relevant physiological and psychological data?

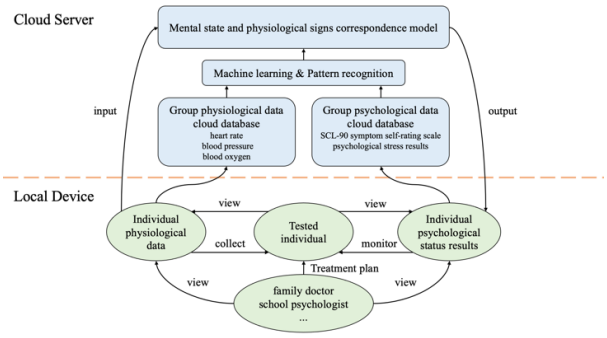

Figure 3. Face video metal stress recognition

In response to the first problem, the monitoring of human physiological indicators can be integrated into daily life, and the non-contact physiological indicator monitoring equipment is able to combine with daily necessities such as embedding face cameras into mirrors, smartphones, and cars, to complete non-contact detection by proposing daily life scenarios. At the same time, it is necessary to increase the convenience of monitoring, shorten the time for physiological data testing, and minimize the impact of testing activities on people, which can not only improve the reliability of data, but also reduce the rejection of monitoring objects to testing. For the second question, it needs reliable non-contact physiological signal detection technology, such as Photo Plethysmo Graphy (PPG), and at the same time increase the development of hardware based on these technologies. The corresponding model of physiological data and psychological data is established through big data and artificial intelligence, and the psychological status of the subjects is obtained through physiological data, which is the focus and core of further research. A complete detection process is shown in Figure 4. There are eleven steps from the collection of raw data at the terminal to the output of the final emotion recognition result. These steps can be divided into 5 main parts.

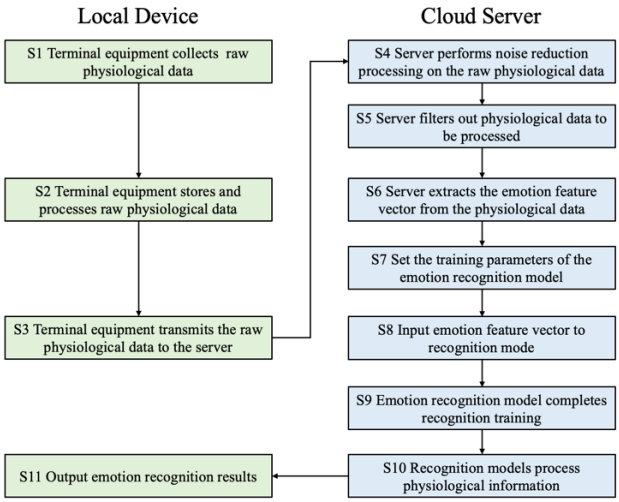

Figure 4. Metal stress recognition process

Part 1: Acquisition of Raw Physiological Data

S1: The user's heart rate, blood pressure, blood oxygen and other raw physiological data are collected in a non-contact manner. Since the smart terminal is non-contact with the user's body parts, the extracted signals containing various noises and electro-magnetic interference. S2: These raw physiological data are temporarily stored in the data pre-processing unit. S3: These raw physiological data can be transmitted to a remote server installed with a physiological-emotional processing module through a 5G network or a mobile medium such as a hard disk.

Part 2: Physiological Data Screening Noise Reduction

S4: After the noise reduction screening pre-processing unit of the physiological data processing module in the server receives the original data, in order to reduce the interference from original data to subsequent steps, compression and noise reduction of the signal should be realized with a very small degree of distortion. S5: After processing the screening and noise reduction, the identified physiological data is then obtained.

Part 3: Extracting Sentiment Features

S6: After receiving the identified data, the emotional feature extraction unit of the physiological data processing module in the server will applies a related algorithm (such as the pan_tompkin algorithm for detecting heart rate complex information) to obtain a sequence of emotional feature vectors.

Part 4: Training the Emotion Model

S7: The physiological-emotion recognition unit of the physiological data recognition module in the server adopts a support vector machine model.

S8: The server transmits the emotion feature vector to the physiological data recognition module as the training data for the physiological-emotion recognition model.

S9: The physiological-emotion recognition model is able to be taught to predict the probability value of each emotional state. After the sample physiology-emotion recognition result is gained, the sample physiology-emotion recognition result and the real physiology-emotion result can be used for comparative training in order to obtain a trained physiology-emotion recognition model.

Part 5: Output Emotion Recognition Results

S10: The physiological data recognition module in the server selects four typical types of emotions for analysis, which are funny, sad, fearful, and calm, and then determines the emotion category corresponding to the highest probability value as the emotion recognition result. S11: The identification result output unit of the physiological data identification module of the server, generates information or data according to the user's request and presents the emotion recognition results to the user.

The emotion feature vector obtained by extracting the feature value of the physiological data is input into the relevant physiological-emotion recognition model, and the emotion recognition result can then be output. Through the above technical process, the efficiency and accuracy of emotion recognition are improved. In addition, under the highly Internet-based environment and its technical support, this paper proposes to extract the optimization results of the image by calculating the data collected and set the learning and training mode at the same time. After a series of processing the results of emotional cognition, the prompt function of constant monitoring and management of emotions can be achieved, and to be shared with relevant personnel in real time.

5 Experiment & Application

To verify the effectiveness of personal physiological data acquisition system based on face video technology. The study has carried out experimental verification with the relevant Internet products currently developed. The experiment needs to collect data from four physiological indicators, like blood pressure, blood oxygen, heart rate and respiratory rate. For the purpose of obtaining accurate experimental test results, the factors that may affect the values of these physiological indicators in a short time should be excluded first. For blood pressure, drinking caffeinated drinks and alcohol, and different postures all will make blood pressure rise accidentally. Usually, people's heart rate and respiratory rate increase sharply shortly after vigorous exercise. Studies indicate that blood glucose level will affect the blood oxygen saturation of the human body in a short time. High blood glucose is easily leading to low blood oxygen saturation. Hence, most people's blood glucose level gradually tends to normal level after three hours of dining.

Based on the above factors, the experiment was arranged in a room with sufficient ventilation and oxygen, and was conducted three hours after dinner every day, for 16 consecutive days. There are two experimental volunteers, male and female. After the test starts, the subjects sat in front of the face camera, which will shoot a 15-second face video. During this process, testers should naturally relax and keep their heads stable. After the video shooting is completed, the system will need several seconds to process the data, and then display the collected data on the interface to the testing subjects (see Figure 5). If a physiological index of the subject is different from the normal value, the test indicators will be marked with different colors on the interface to remind the user paying attention to his/her personal situation. The data collected in the experiment is shown in the following Table 1.

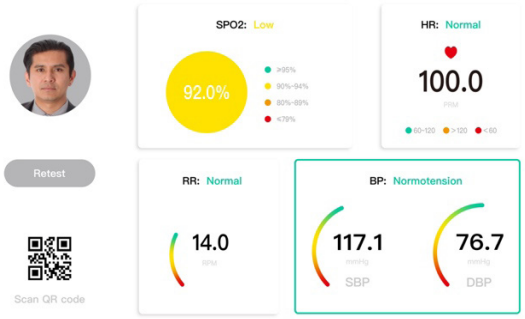

Figure 5. Physiological data displaying interface

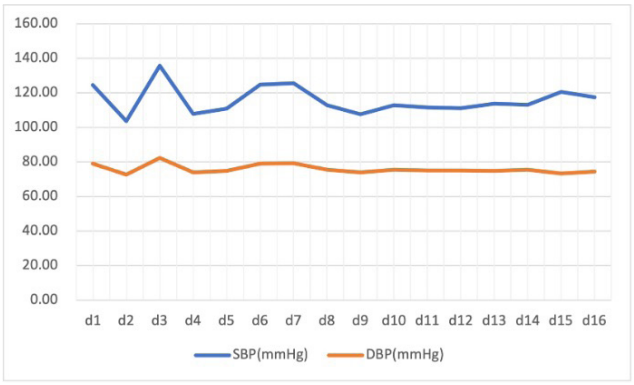

Figure 6. Female blood pressure line chart

The line graph (see Figure 6) drawn according to the collected data shows a trend of personal physiological status, through comparison with the physiological-psychological correspondence model in the big data network. It can continuously monitor on the change of personal mental pressure. Through the above system, the real-time recording of physiological indicators of the detected object can be achieved. The psychological status of the monitored object is able to be attained through the corresponding model in the background. The monitoring results of physiological and psychological conditions will be synchronized in real-time to the internet terminal devices or personal cloud platforms of the service recipients, such as mobile phones, smartwatches, personal computers, or online drives. After each test is completed, the backend will issue a briefing based on real-time monitoring data, providing early warnings for potential problems, and providing suggestions on whether further medical assistance is needed. At the same time, family doctors and family members can also receive these data and reports at anytime and anywhere that a remote health management and monitoring of users can be achieved.

Table 1. Physiological data of subjects (male/female)

Date	SpO2 (%)	HR	RR	SBP (mmHg)	DBP (mmHg)
d1	92/92	96/78	14/14	119.56/124.40	77.49/78.95
d2	97/92	99/106	14/14	107.62/103.59	73.90/72.69
d3	92/93	84/68	12/14	122.51/135.60	78.38/82.30
d4	93/94	123/109	12/19	112.72/107.90	75.44/74.00
d5	92/92	77/88	16/19	125.10/110.90	79.16/74.90
d6	92/94	107/87	14/21	118.16/124.70	77.07/79.00
d7	92/93	90/80	12/14	124.49/125.60	78.98/79.30
d8	92/93	98/92	12/18	110.56/112.90	74.79/75.50
d9	94/94	109/121	12/12	109.82/107.60	74.56/73.90
d10	92/93	76/106	14/18	121.90/112.80	78.20/75.40
d11	94/93	84/96	21/16	125.60/111.60	79.30/75.10
d12	92/92	91/117	19/23	113.50/111.20	75.70/75.00
d13	92/92	90/90	23/17	123.20/113.80	78.60/74.80
d14	92/93	100/93	14/19	117.10/113.00	76.70/75.50
d15	93/93	90/100	19/15	106.10/125.50	73.40/73.40
d16	93/93	88/83	12/14	115.30/117.40	77.20/74.50

6 Conclusions & Discussion

The continuous mental stress test based on non-contact sensors realizes the trans-formation from physiological data to psychological data and improves the efficiency of mental stress detection. But the accuracy of the output results depends on the reliability of the corresponding model, which requires big data analysis method and support of massive data. In the era of big data, data is not just about extra output or subsidiary force or core competency, but raw materials in the process of data commercialization, which is an inevitable trend. With the explosive growth of data volume, more and more data are processed into various kinds of valuable products.

The study finds that the value and meanings of data artifacts are closely related to the expressions of data. Evidently, psychological problems are somewhat hidden, there may be no obvious external personal behavior in its development stage. At this time, if patients do not take the initiative to conduct psychological counseling in time, it will often make the psychological status worse. Therefore, it is necessary to quickly identify individual psychological conditions and carry out the correct intervention. The psychological state of people is closely related to such physiological indicators as blood oxygen, blood pressure, respiration, and heart rate. It is theoretically feasible to monitor on the psychological state by collecting these physiological parameters. As a result, the human psychological condition detection system based on PPG can not only monitor on the personal psychological pressure at the first time, but also need to reduce the cost of traditional psychological pressure detection and shorten the detection cycle. As explored by the study, the non-contact detection method can collect various physiological data of people in the natural state, and such data often has higher accuracy.

Of course, under the current technical conditions, this method still retains several shortcomings. In terms of detection means, PPG is a method to detect changes in blood volume in living tissues by photoelectric means, however, this technology is vulnerable to the interference of environmental light changes and individual movements, which affect the accuracy of the experimental results. As such, it requires the development of filtering technology to continuously improve the accuracy of detection means. From the perspective of analysis model, a complete and accurate corresponding model needs big data as the basis. Thus, the more sample data collected, the better result achieved where the accuracy of this method can be improved. Theoretically, the study appeals to build a corresponding model of psychophysiological mapping analysis, but the final completion of this model needs to be verified through a series of experiments. And the theoretical model needs to be revised and improved continuously by collecting large numbers of sample of physiological data from peoples with different mental states to optimize the accuracy of data to improve users' ability to be alerted when psychological pressure is increased.

In addition, when individuals are facing physical and mental pressure, the diversity and complexity of the required early warning services can no longer rely solely on mastering the inherent static and simple factors. Instead, further attention should be paid to the environment, time, space, and other corresponding variables. Therefore, how to provide an information and management platform combining with the Internet of Things and strengthen the real-time feedback of early warning service messages, improve the real-time management of personal service situations, and obtain responding command of related personal mental information at any time via the setting of mobile devices. Through this platform and the application of internet technology like Web 2.0 and its upgraded version Web 3.0, service content can be systematically recorded, the physiological and psychological conditions of service recipients can be monitored, analyzed, and transmitted where measurement values can be provided in real-time to improve personal health management. With the convenience of WIFI and related internet technologies, family physicians and family members can use this platform

at anytime and anywhere to access such remote health management and monitoring of users. Eventually, by fully recording the service content and providing real-time measurements of relevant physiological conditions to the contact person, such servicing relationships between the recipients, their families, and relevant personnel are able to be strengthened and secured in maintaining the best service quality for those in need.

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Biographies

Manhai Li works for Chongqing University of Posts and telecommunications, once served as ZTE's R & D agile Coach & user experience director of cloud computing products. He holds bachelor and master in electronic communication and doctorate in design, and practice in interdisciplinary integration of communication, computer, and design.

Xunyi Zheng is a postgraduate student at the School of Media Arts, Chongqing University of Posts and Telecommunications. His research includes information visualization design and experience design. Also, he participated in the research of non-contact physiological data acquisition project based on face video recognition technology.