

METHOD AND SYSTEM FOR ANALYZING HUMAN EMOTIONAL STATE BASED ON HUMAN SKIN REISTANCE MEASUREMENT

This patent application claims a priority from a Chinese patent application No. 201410128494.1, filed on April 1, 2014, and named “method and system for analyzing human emotional state based on human skin resistance measurement”, the content of which is incorporated by reference herein in its entirety.

Field of Invention

This invention is related to human body measurement, and more specifically to a method for analyzing human emotional state based on human skin resistance measurement.

Background

When the living things are affected by outside stimulus and becomes emotional, the difference in potential between two points on the body increases, leading to the skin resistance decrease. This phenomenon is called bioelectricity reflection. Studies of this phenomenon are not very deep. Some authoritative explanations indicate that the change of human skin resistance is related to sweat gland activity. When human becomes excited, the sweat gland becomes more active. The existence of electrolyte in sweat leads to changes in skin resistance.

Researchers have analyzed the relationship between emotions and resistance. However, they were always committed to why emotional fluctuation will affect the change of human skin resistance. They only used the change of resistance value to distinguish whether test subjects are in calmness state or excitement state. In this way, not only cannot reflect test subjects' excitement level and but also, for different people whose physiological characteristics are very different from each other, there are many uncertain factors. For example, some people secrete more sweat when becoming

excited, leading to obvious resistance changes, while some others do not. For people with different weights, even under same measurement condition, the change of skin resistance would be different. The changing ranges of skin resistance of different individuals are very different from each other. Thus, cannot directly use the change of resistance value to determine whether test subjects are in calmness state or excitement state. This invention aims to overcome the deficiency in this aspect.

Summary of the Invention

To overcome issues in the previous studies on the emotional state evaluation where only excitement state and calmness state are determined and the individual difference is not considered, the present invention discloses a method to evaluation emotional state based on skin resistance measurement. Using the phenomenon that emotional fluctuation will affect the change of human skin resistance, the method analyzes the degrees of the emotional changes qualitatively and quantitatively. The method is then used in practice.

Based on the first aspect of the present invention, the present invention provides a method for evaluating human emotional state based on human skin resistance measurement, the method comprising:

Step 1: initializing relevant parameters;

Step 2: collecting human skin resistance data from test subject;

Step 3: analyzing the collected human skin resistance data;

Step 4: outputting an evaluation result of the human emotional state to the test subject;

wherein the step of initializing relevant parameters includes:

setting an initial value of an emotional state value *CurrES*, a minimum value and a maximum value of the emotional state value;

setting a first resistance threshold value *lowThresh* and a second resistance threshold value, *highThresh*;

wherein when the collected human skin resistance data is less than the pre-set

lowThresh, the human body is in an excitement state; when the collected human skin resistance value is greater than the pre-set *highThresh*, the human body is in a calmness state;

wherein the step of analyzing the collected human skin resistance data includes raw data pre-processing, and resistance threshold values analysis, slope analysis, comprehensive analysis of slope and fluctuation duration, and comprehensive analysis of slope, fluctuation duration and resistance threshold values.

Furthermore, the said resistance threshold values analysis comprises:

if an average value of the human skin resistance data in the current window is less than the *lowThresh*, increasing the emotional state value *CurrES* by *ZZZ*;
otherwise

if an average value of the human skin resistance data in the current window is more than the *highThresh*, decreasing the emotional state value *CurrES* by *ZZZ*;
otherwise

if an average value of the human skin resistance data in the current window is more than $\beta_1 * MinHistory$, decreasing the emotional state value *CurrES* by *XXX*;
otherwise

if an average value of the human skin resistance data in the current window is less than $\alpha_1 * MaxHistory$, increasing the emotional state value *CurrES* by *XXX*;
otherwise the emotional state value *CurrES* has no change;

wherein the average value of human skin resistance data in the current window refers to an average value of human skin resistance data collected in a window with a length of *stepSize*; the *MaxHistory* and *MinHistory* are respectively a maximum value and a minimum value among the average values of the human skin resistance data in the *maxHistoryLen* historical windows immediately before the current window; the *maxHistoryLen* is set in a value range of (3, 20); α_1 and β_1 are coefficients to detect the sensitivity of the resistance decreasing and increasing changes; α_1 is set in a value

range of (0, 1) and β_1 is set in a value range of value in (1, 5); ZZZ and XXX are changing steps of the emotional state value; ZZZ and XXX are set in a value range of (1, 5) and $ZZZ > XXX$.

Furthermore, the said initial value of the emotional state value *CurrES* is set to 1; its minimum value, *MINSTATE*, is set to 1; its maximal value, *MAXSTATE*, is set to 20; based on a sampling data of finger skin, the *lowThresh* is set to 50 K Ω and the *highThresh* is set to 800 K Ω ; the length of a window *stepSize* is set to 80; the *maxHistoryLen* is set to 5; ZZZ is set to 2; XXX is set to 1; α_1 and β_1 are set to 0.8 and 1.2, respectively.

Furthermore, the said slope analysis comprises:

1) detect resistance change; if all average values of the human skin resistance data of the *SlopesLen* continuous windows are less than $\alpha_2 * MaxHistory$ or more than $\beta_2 * MinHistory$, wherein α_2 and β_2 are coefficients to detect the sensitivity of the resistance decreasing and increasing changes; α_2 is set to a value in (0, 1) and β_2 is set to a value in (1, 5); the slope of these *SlopesLen* windows is calculated and recorded as:

$$Slopes = (aveValue2 - aveValue1) / (SlopesLen * stepSize)$$

wherein *aveValue1* is the average value of the human skin resistance data of the first window among the *SlopesLen* windows and *aveValue2* is the average value of the human skin resistance data of the last window among the *SlopesLen* windows;

2) if $Slopes > 0$, and $Slopes > \xi * MeanUpSlopes$, decreases *CurrES* by DDD; otherwise if $\eta * MeanUpSlopes < Slopes \leq \xi * MeanUpSlopes$, decreases *CurrES* by ZZZ; otherwise decreases *CurrES* by XXX;

if $Slopes < 0$, and $|Slopes| > \xi * MeanDownSlopes$, increases *CurrES* by DDD;

otherwise if $\eta * MeanDownSlopes < |Slopes| \leq \xi * MeanDownSlopes$, increases

CurrES by *ZZZ*; otherwise increases *CurrES* by *XXX*;
 wherein *MeanUpSlopes* and *MeanDownSlopes* are respectively the average values of the previous *N* ascending slopes and the average absolute values of the previous *N* descending slopes (the ascending slope refers to slope larger than 0 and the descending slope refers to slope less than 0); ξ , η are slope analysis parameters, are set to value in (0, 1), and $\xi > \eta$; *DDD* is changing step of the emotional state value, is set to a value range of (1, 5), and *DDD* > *ZZZ* > *XXX*.

Furthermore, the said α_2 , β_2 are set to 0.98 and 1.02, respectively; ξ is set to 0.85; η is set to 0.5; *DDD* is set to 3; *N* is set to 5.

Furthermore, the said comprehensive analysis of slope and fluctuation duration comprises:

to obtain the duration parameter:

if *Slopes* > 0 and the average value of the human skin resistance data in the current window is more than $\beta_2 * MinHistory$, increasing the duration time of calmness, *UpDuration*, by the time length of a data collection window;

if *Slopes* < 0 and the average value of the human skin resistance data in the current window is less than $\alpha_2 * MaxHistory$, increasing the duration time of excitement, *DownDuration*, by the time length of a window;

to update the emotional state value according to the duration parameter:

if *Slopes* > 0 and *UpDuration* is more than *RecoverTime*, decreasing *CurrES* by *XXX*;

if *Slopes* < 0 and *DownDuration* is more than *ExcitTime*, increasing *CurrES* by *XXX*;

wherein *RecoverTime* is calmness duration; *ExcitTime* is excitement duration; both are set to values in the range of (0, 200s).

Furthermore, the said *RecoverTime* is set to 8s and the said *ExcitTime* is set to 5s.

Furthermore, the said comprehensive analysis of slope, fluctuation duration and resistance threshold values comprises:

if $Slopes > 0$, and *UpDuration* is less than *RecoverTime*, the emotional state value *CurrES* has no change; otherwise if *UpDuration* is more than *RecoverTime*, and the average value of the human skin resistance data in the current window is more than $\beta_1 * MinHistory$, decreasing *CurrES* by *ZZZ*; otherwise decreasing *CurrES* by *XXX*;

if $Slopes < 0$, and *DownDuration* is less than *ExcitTime*, the emotional state value *CurrES* has no change; if *DownDuration* is more than *ExcitTime*, and the average value of the human skin resistance data in the current window is less than $\alpha_1 * MaxHistory$, increasing *CurrES* by *ZZZ*; otherwise increasing *CurrES* by *XXX*.

Based on a sampling data of finger skin, the *lowThresh* is set to 50 K Ω and the *highThresh* is set to 800 K Ω .

Because the conductance is the reciprocal of the resistance, the present method can also be applied to evaluate human emotional state based on skin conductance measurement.

Based on the second aspect of the present invention, the present invention provides a system for evaluating human emotional state based on human skin resistance measurement to execute the present method, wherein the system contains medical sensor heads, a bridge circuit for measuring human skin resistance/conductance, an amplifier circuit, an A/D converter circuit, a CPU, and a human machine interactive interface.

The present invention combines human skin resistance threshold value analysis, resistance changing slope analysis, and excitement and calmness fluctuation duration analysis. To overcome the individual difference problem, the invention applies an adaptive algorithm to distinguish calmness state and excitement state more precisely. By using the emotional state parameter, the invention classifies the excitement state of the test subject into different levels and different levels reflect different emotional states. Applying the research pattern of data collection, analysis, and feedback, the invention can be used in wearable device development in the future.

Brief Description of the Drawings

Figure 1 shows the basic framework of the invention.

Figure 2 shows flowchart of whole analysis of the invention.

Figure 3 shows flowchart of resistance threshold value analysis of the invention.

Figure 4 shows flowchart of slope analysis of the invention.

Figure 5 shows flowchart of fluctuation duration analysis of the invention.

Figure 6 shows flowchart of the comprehensive analysis of slope and fluctuation duration of the invention.

Figure 7 shows flowchart of the comprehensive analysis of slope, fluctuation duration, and resistance threshold value of the invention.

Figure 8 shows window partition of the invention.

Figure 9 shows the principle diagram of the system of the invention.

Figure 10 is the graph of resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 2 seconds for 20 seconds.

Figure 11 is the graph of resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 2 seconds for 60 seconds.

Figure 12 is the graph of resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 2 seconds for 60 seconds.

Figure 13 is the graph of resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 10 seconds for 60 seconds.

Detailed Description of the Invention

The present invention is further explained with the drawings.

The framework of the invention is shown in Figure 1. Firstly collect the skin resistance of the test subject, and analyze the data collected. Then, feedback the analysis results of emotional state to users through flashing or number display. Data analysis in the framework comprises data pre-processing and parameters analysis. Parameters analysis comprises resistance threshold value analysis, resistance changing slope analysis, and the comprehensive analysis of resistance threshold value, slope, and excitement and calmness fluctuation duration. See Figure 2.

1. Data Pre-Processing

Due to the prescribed measurement range of the skin resistance data collection device, the collected value may go beyond the range and the collected data would be zero. Thus, need to pre-process the collected data to replace the zero data with its previous data. Besides, because the fluctuation of the collected data from test subject is strong, need to average to reduce the fluctuation for easier analysis by choosing a window with certain window size, *stepSize*, as shown in Figure 7. The window size, *stepSize*, is set to 80, i.e., 80 raw skin resistance values collected in one window. The sampling frequency is set to 50Hz, i.e., one window covering the resistance value in 1.6 second.

2. Parameters Analysis

1). Resistance Threshold Value Analysis. See Figure 3 for detailed flowchart.

① Common feature analysis

Observing all the data collected from finger skin, when the skin resistance is less than 50 K Ω , 90% of test subjects are in excitement state. When the skin resistance is more than 800 K Ω , 80% of test subjects are in calmness state. Thus, set *lowThresh* to 50 K Ω and *highThresh* to 800 K Ω .

When evaluating emotional state, common feature analysis would be applied first. If the resistance value is less than 50 K Ω , increases the emotional state value *CurrES* by *ZZZ*. *ZZZ* is set to 2. If the resistance value is more than 800 K Ω , decreases the emotional state value *CurrES* by *ZZZ*.

The values of *lowThresh* and *highThresh* could well reflect the common feature in test subjects.

② Resistance Threshold Learning

There are 4 other parameters to be set: *MaxHistory*, *MinHistory*, α_1 and β_1 . α_1 and β_1 are set to 0.8 and 1.2, respectively. *MaxHistory* and *MinHistory* are respectively the maximum and minimum values among the average resistance values of the *maxHistoryLen* historical windows immediately before the current window. *maxHistoryLen* is set to 4. If the average resistance value in current window is more than $\beta_1 * \text{MinHistory}$, showing the skin resistance value of the test subject is becoming larger and the test subject transits from excitement state to calmness state, decreases *CurrES* by *XXX*. Pay attention when decreasing *CurrES* that its minimal value, *MINSTATE*, is set to 1. If the average resistance value in current window is less than $\alpha_1 * \text{MaxHistory}$, showing the skin resistance value of the test subject is becoming

smaller and the test subject transits from calmness state to excitement state, increases *CurrES* by XXX. XXX is set to 1. Pay attention when increasing *CurrES* that its maximal value, MAXSTATE, is set to 20.

By using adaptive threshold algorithm can more accurately determine the emotional state of the test subject. Adaptive threshold refers that the analysis to estimate the resistance change is based on the average resistance value in the previous windows. When the windows shift forward with time, the previously stored average resistance values shift forward as well. Self-adaptive refers that the comparison object is different from time to time as the average resistance value in the previous window is used in comparison. The average resistance value in the previous window is not a fixed value.

2). Slope Analysis. See Figure 4 for detailed flowchart.

① Slope calculation

Firstly detect the resistance change. If all average resistance values of the *SlopesLen* continuous windows are less than $\alpha_2 * MaxHistory$ or more than $\beta_2 * MinHistory$, record all average resistance values of these *SlopesLen* windows. *SlopesLen* is set to 5. α_2 and β_2 are set to 0.98 and 1.02, respectively. The slope is calculated

$$Slopes = (aveValue2 - aveValue1) / (SlopesLen * stepSize)$$

wherein *aveValue2* is the average value of the last window among the *SlopesLen* windows, and *aveValue1* is the average value of the first window among the *SlopesLen* windows.

② Different slope classification

If current *Slopes* > 0 , and more than $\xi * MeanUpSlopes$, showing the test subject transits from excitement state to calmness state quickly, then decreases *CurrES* by

DDD. DDD is set to 3. If current $Slopes < 0$, and its absolute value is more than $\xi * MeanDownSlopes$, showing the test subject transits from calmness state to excitement state quickly, then increases $CurrES$ by DDD. $MeanUpSlopes$ and $MeanDownSlopes$ are respectively the average values of the ascending slopes and the average absolute values of the descending slopes. ξ is set to 0.85.

If current $Slopes > 0$, more than $\eta * MeanUpSlopes$ and less than $\xi * MeanUpSlopes$, showing the test subject transits from excitement state to calmness state slowly, then decreases $CurrES$ by ZZZ. ZZZ is set to 2. If current $Slopes < 0$, its absolute value is more than $\eta * MeanDownSlopes$ and less than $\xi * MeanDownSlopes$, showing the test subject transits from calmness state to excitement state slowly, then increases $CurrES$ by ZZZ. η is set to 0.5.

If current $Slopes > 0$, and less than $\eta * MeanUpSlopes$, then decreases $CurrES$ by XXX. XXX is set to 1. If current $Slopes < 0$, and its absolute value is less than $\eta * MeanDownSlopes$, then increases $CurrES$ by XXX.

Pay attention when increasing $CurrES$ that cannot go above its maximal value, MAXSTATE (20). Pay attention when decreasing $CurrES$ that cannot go below its minimal value, MINSTATE (1).

3). Comprehensive analysis of resistance threshold value, slope, and fluctuation duration. See Figure 5, Figure 6, Figure 7 for more details.

① To obtain fluctuation duration parameter

As shown in Figure 5, when determine the duration time of excitement and the duration time of calmness, the slope value from slope analysis and the average resistance value from resistance threshold value analysis are used. If $Slopes > 0$ and the average resistance value in current window is more than $\beta_2 * MinHistory$, then the duration time of calmness, $UpDuration$, increased by the time length of a data collection window, $stepSize$. Otherwise, if $Slopes < 0$ and the average resistance value in current window is less than $\alpha_2 * MaxHistory$, then the duration time of excitement, $DownDuration$, increased by $stepSize$. The initial values of $UpDuration$ and $DownDuration$ are both 0.

② Comprehensive analysis of slope and fluctuation duration time

As shown in Figure 6, if $Slopes > 0$ and the duration time of calmness, $UpDuration$, is more than $RecoverTime$, then decreases $CurrES$ by XXX. $RecoverTime$ is set to 8s. If $Slopes < 0$ and $DownDuration$ is more than $ExcitTime$, then increases $CurrES$ by XXX. $ExcitTime$ is set to 5s.

DDD, ZZZ, XXX are set to 3, 2, 1, respectively, showing different changing level of emotional state.

③ Comprehensive analysis of resistance threshold value, slope, and fluctuation duration

To more accurately evaluate the excitement level of the test subject, the comprehensive analysis of slope, resistance threshold value, and fluctuation duration is applied to analyze the emotional state. As shown in Figure 7, first check whether current *Slopes* is positive. If *Slopes* > 0 , the test subject transits from excitement state to calmness state. If the duration time of calmness, *UpDuration*, is more than *RecoverTime*, and the average resistance value in current window is more than $\beta_1 * MinHistory$, then decreases *CurrES* by ZZZ; otherwise decreases *CurrES* by XXX. *RecoverTime* is set to 8s. If *Slopes* < 0 , the test subject transits from calmness state to excitement state. If the duration time of excitement, *DownDuration*, is more than *ExcitTime*, and the average resistance value in current window is less than $\alpha_1 * MaxHistory$, then increases *CurrES* by ZZZ; otherwise increases *CurrES* by XXX. *ExcitTime* is set to 5s.

Figure 9 shows the principle diagram of the system for analyzing human emotional state based on human skin resistance measurement. The system comprises medical sensor heads, the bridge circuit to measure resistance/conductance, amplifier circuit, A/D converter circuit, CPU, and human machine interactive interface. The system collects human skin resistance/conductance data and analyzes human emotional state based on human skin resistance/conductance change. The system applies the method in the present invention.

Figure 10 to Figure 13 are the graph of skin resistance data and emotional state values vs. time. The *inputData* is the skin resistance data after pre-processing. The *EstimatedState* is the emotional state value by the comprehensive analysis of resistance threshold value, slope and fluctuation duration.

Example 1

Figure 10 shows skin resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 2 seconds for 20 seconds. Figure 11 shows skin resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 2 seconds for 60 seconds. Comparing the two results, find that, with longer deep breath generating higher excitement level, the larger emotional state value is detected.

Example 2

Figure 12 shows skin resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 2 seconds for 60 seconds. Figure 13 shows skin resistance data and emotional state values vs. time, observed when the frequency of deep breathing is once every 10 seconds for 60 seconds. Comparing the two results, find that, with higher deep breath frequency, the larger emotional state value is detected.

The results of the two examples show that the present invention can distinguish calmness state and excitement state more precisely to indicate the different excitement levels of test subjects.

The present invention combines human skin resistance threshold value analysis, resistance changing slope analysis, and excitement and calmness fluctuation duration analysis. To overcome the individual difference problem, the invention applies an adaptive algorithm to distinguish calmness state and excitement state more precisely. By using the emotional state parameter, the invention classifies the excitement state of the test subject into different levels and different levels reflect different emotional states. Applying the research pattern of data collection, analysis, and feedback, the invention can be used in wearable device development in the future.

Claims

1. A method for evaluating human emotional state based on human skin resistance measurement, characterized in that, the method comprising:

Step 1: initializing relevant parameters;

Step 2: collecting human skin resistance data from test subject;

Step 3: analyzing the collected human skin resistance data;

Step 4: outputting an evaluation result of the human emotional state to the test subject;

wherein the step of initializing relevant parameters includes:

setting an initial value of an emotional state value *CurrES*, a minimum value and a maximum value of the emotional state value;

setting a first resistance threshold value *lowThresh* and a second resistance threshold value, *highThresh*;

wherein when the collected human skin resistance data is less than the pre-set *lowThresh*, the human body is in an excitement state; when the collected human skin resistance value is greater than the pre-set *highThresh*, the human body is in a calmness state;

wherein the step of analyzing the collected human skin resistance data includes raw data pre-processing, and resistance threshold values analysis, slope analysis, comprehensive analysis of slope and fluctuation duration, and comprehensive analysis of slope, fluctuation duration and resistance threshold values.

2. The method for evaluating human emotional state based on human skin resistance measurement according to **claim 1**, characterized in that, said resistance threshold values analysis comprises:

if an average value of the human skin resistance data in the current window is less than the *lowThresh*, increasing the emotional state value *CurrES* by *ZZZ*;
otherwise

if an average value of the human skin resistance data in the current window is more than the *highThresh*, decreasing the emotional state value *CurrES* by *ZZZ*;
otherwise

if an average value of the human skin resistance data in the current window is more than $\beta_1 * MinHistory$, decreasing the emotional state value *CurrES* by *XXX*;
otherwise

if an average value of the human skin resistance data in the current window is less than $\alpha_1 * MaxHistory$, increasing the emotional state value *CurrES* by *XXX*;
otherwise the emotional state value *CurrES* has no change;

wherein the average value of human skin resistance data in the current window refers to an average value of human skin resistance data collected in a window with a length of *stepSize*; the *MaxHistory* and *MinHistory* are respectively a maximum value and a minimum value among the average values of the human skin resistance data in the *maxHistoryLen* historical windows immediately before the current window; the *maxHistoryLen* is set in a value range of (3, 20); α_1 and β_1 are coefficients to detect the sensitivity of the resistance decreasing and increasing changes; α_1 is set in a value range of (0, 1) and β_1 is set in a value range of value in (1, 5); *ZZZ* and *XXX* are changing steps of the emotional state value; *ZZZ* and *XXX* are set in a value range of (1, 5) and *ZZZ*>*XXX*.

3. The method for evaluating human emotional state based on human skin resistance measurement according to **claim 2**, characterized in that, the initial value of the emotional state value *CurrES* is set to 1; its minimum value, *MINSTATE*, is set to 1; its maximal value, *MAXSTATE*, is set to 20; based on a sampling data of finger skin, the *lowThresh* is set to 50 K Ω and the *highThresh* is set to 800 K Ω ; the length of a window *stepSize* is set to 80; the *maxHistoryLen* is set to 5; *ZZZ* is set to 2; *XXX* is set to 1; α_1 and β_1 are set to 0.8 and 1.2, respectively.

4. The method for evaluating human emotional state based on human skin resistance measurement according to **claim 2**, characterized in that, the slope analysis comprises: 1) detect resistance change in real-time; if all average values of the human skin resistance data of the *SlopesLen* continuous windows are less than $\alpha_2 * MaxHistory$ or more than $\beta_2 * MinHistory$, wherein α_2 and β_2 are coefficients to detect the sensitivity of the resistance decreasing and increasing changes; α_2 is set to a value in (0, 1) and β_2 is set to a value in (1, 5); the slope of these *SlopesLen* windows is calculated and recorded as:

$$Slopes = (aveValue2 - aveValue1) / (SlopesLen * stepSize)$$

wherein *aveValue1* is the average value of the human skin resistance data of the first window among the *SlopesLen* windows and *aveValue2* is the average value of the human skin resistance data of the last window among the *SlopesLen* windows;

2) if $Slopes > 0$, and $Slopes > \xi * MeanUpSlopes$, decreases *CurrES* by DDD; otherwise if $\eta * MeanUpSlopes < Slopes \leq \xi * MeanUpSlopes$, decreases *CurrES* by ZZZ; otherwise decreases *CurrES* by XXX;

if $Slopes < 0$, and $|Slopes| > \xi * MeanDownSlopes$, increases *CurrES* by DDD; otherwise if $\eta * MeanDownSlopes < |Slopes| \leq \xi * MeanDownSlopes$, increases *CurrES* by ZZZ; otherwise increases *CurrES* by XXX;

wherein *MeanUpSlopes* and *MeanDownSlopes* are respectively the average values of the previous *N* ascending slopes and the average absolute values of the previous *N* descending slopes, wherein the ascending slope refers to slope larger than 0 and the descending slope refers to slope less than 0; ξ , η are slope analysis parameters, are set to value in (0, 1), and $\xi > \eta$; DDD is changing step of the emotional state value, is set to a value range of (1, 5), and DDD > ZZZ > XXX.

5. The method for evaluating human emotional state based on human skin resistance measurement according to **claim 4**, characterized in that, said α_2 , β_2 are set to 0.98 and 1.02, respectively; ξ is set to 0.85; η is set to 0.5; DDD is set to 3; N is set to 5.

6. The method for evaluating human emotional state based on human skin resistance measurement according to **claim 4**, characterized in that, the comprehensive analysis of slope and fluctuation duration comprises:

to obtain the duration parameter:

if $Slopes > 0$ and the average value of the human skin resistance data in the current window is more than $\beta_2 * MinHistory$, increasing the duration time of calmness, $UpDuration$, by the time length of a data collection window;

if $Slopes < 0$ and the average value of the human skin resistance data in the current window is less than $\alpha_2 * MaxHistory$, increasing the duration time of excitement, $DownDuration$, by the time length of a window;

to update the emotional state value according to the duration parameter:

if $Slopes > 0$ and $UpDuration$ is more than $RecoverTime$, decreasing $CurrES$ by XXX;

if $Slopes < 0$ and $DownDuration$ is more than $ExcitTime$, increasing $CurrES$ by XXX;

wherein $RecoverTime$ is calmness duration; $ExcitTime$ is excitement duration; both are set to values in the range of (0, 200s).

7. The method for evaluating human emotional state based on human skin resistance measurement according to **claim 6**, characterized in that, said $RecoverTime$ is set to 8s and said $ExcitTime$ is set to 5s.

8. The method for evaluating human emotional state based on human skin resistance

measurement according to **claim 6**, characterized in that, the comprehensive analysis of slope, fluctuation duration and resistance threshold values comprises:

if $Slopes > 0$, and $UpDuration$ is less than $RecoverTime$, the emotional state value $CurrES$ has no change; otherwise if $UpDuration$ is more than $RecoverTime$, and the average value of the human skin resistance data in the current window is more than $\beta_1 * MinHistory$, decreasing $CurrES$ by ZZZ ; otherwise decreasing $CurrES$ by XXX ;

if $Slopes < 0$, and $DownDuration$ is less than $ExcitTime$, the emotional state value $CurrES$ has no change; if $DownDuration$ is more than $ExcitTime$, and the average value of the human skin resistance data in the current window is less than $\alpha_1 * MaxHistory$, increasing $CurrES$ by ZZZ ; otherwise increasing $CurrES$ by XXX .

9. The method for evaluating human emotional state based on human skin resistance measurement according to any one of **claims 1-8**, characterized in that, the said resistance is the reciprocal of the resistance; human emotional state evaluation is based on human skin conductance measurement.

10. A system for evaluating human emotional state based on human skin resistance measurement to execute any method according to any one of claim 1 to claim 9, characterized in that, the system contains medical sensor heads, a bridge circuit for measuring human skin resistance/conductance, an amplifier circuit, an A/D converter circuit, a CPU, and a human machine interactive interface.