

RISK PREDICTION METHOD AND APPARATUS, STORAGE MEDIUM, AND SERVER

[1] The present application claims priority of Chinese Patent Application No. CN201810496195.1, entitled "RISK PREDICTION METHOD, STORAGE MEDIUM, AND SERVER", filed to China Patent Office on May 22, 2018, the content of which is incorporated herein by reference.

TECHNICAL FIELD

[2] The present application relates to the field of information monitoring, and in particular, to a risk prediction method, a risk prediction apparatus, a storage medium, and a server.

BACKGROUND

[3] For bank loan application, a credit applicant usually needs to go through a credit interview, during which a risk appraiser interviews the credit applicant to verify relevant information. The credit applicant usually fills out credit materials in paper form, and the risk appraiser audits the credit material filled out by the credit applicant, predicts the loan repayment capacity of the credit applicant in the future through an interview with the credit applicant, and puts forward risk prevention and control measures.

[4] Practically, the prediction of the credit applicant's ability of repaying the loan in the future that based on the paper application and the risk appraise to propose the risk prevention and control measures mainly rely on the credit applicant's integrity in filling out the materials and the risk appraiser's experience in risk prediction. This lacks objective auxiliary judgments, and is likely to cause inaccurate prediction of the repayment ability, thus affecting the accuracy of the proposed risk prevention and control measures.

[5] In summary, the existing risk prediction methods mainly rely on the credit applicant's integrity in filling out the materials and the risk appraiser's experience, and lack some objective auxiliary judgments. Therefore, it may easily result in low prediction accuracy of the repayment ability.

TECHNICAL PROBLEMS

[6] Embodiments of the present application provide a risk prediction method, a risk prediction apparatus, a storage medium, and a server, to solve the problems of low risk predication accuracy

and low efficiency due to the fact that existing risk prediction methods mainly rely on a credit applicant's integrity in filling out materials and a risk appraiser's experience, and lack some objective auxiliary judgments.

TECHNICAL SOLUTIONS

[7] A first aspect of an embodiment of the present application provides a risk prediction method, which includes:

[8] obtaining a video image of an applicant during an interview;

[9] clustering video frames in the video image to determine a key frame video image;

[10] determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and

[11] performing risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

[12] A second aspect of an embodiment of the present application provides a risk prediction apparatus, which includes:

[13] a video image acquisition module, configured to obtain a video image of an applicant during an interview;

[14] a key image determination module, configured to cluster video frames in the video image to determine a key frame video image;

[15] a fraud probability determination module, configured to derive a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and

[16] a risk prediction module, configured to perform risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

[17] A third aspect of an embodiment of the present application provides a server, which includes a storage and a processor, where the storage stores computer readable instructions executable on the processor, and when the processor executes the computer readable instructions, the following steps are implemented:

- [18]obtaining a video image of an applicant during an interview;
- [19]clustering video frames in the video image to determine a key frame video image;
- [20]determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and
- [21]performing risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.
- [22]A fourth aspect of an embodiment of the present application provides a computer readable storage medium which stores computer readable instructions, where when the computer readable instructions are executed by a processor, the following steps are implemented:
- [23]obtaining a video image of an applicant during an interview;
- [24]clustering video frames in the video image to determine a key frame video image;
- [25]determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and
- [26]performing risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

BENEFICIAL EFFECTS

[27]In the embodiments of the present application, by acquiring a video image of an applicant during an interview, video frames in the video image are clustered to determine a key frame video image, then a fraud probability of a micro-expression corresponding to the key frame video image is determined according to the determined key frame video image and a micro-expression fraud probability model, and finally risk prediction of the applicant's repayment ability is performed according to the determined fraud probability of the micro-expression corresponding to the key frame video image. In the solution, by analyzing the micro-expression of the applicant during the interview, the applicant's fraud probability is evaluated, and the risk prediction is performed on the applicant's repayment ability according to the fraud probability, which provides objective auxiliary measures for predicting and evaluating the applicant's repayment ability, thereby improving the accuracy of risk prediction and the efficiency of prediction.

BRIEF DESCRIPTION OF DRAWINGS

[28] In order to illustrate the technical solutions in the embodiments of the present application more clearly, the accompanying diagrams are used to describe the solution. Obviously, the accompanying diagrams in the following description are only some embodiments of the present application. For ordinary persons having skills in the art, other accompanying drawings may also be obtained without creative labor.

[29] FIG. 1 is an implement flowchart of a risk prediction method according to an embodiment of the present application;

[30] FIG. 2 is a specific implement flowchart of step S102 of a risk prediction method according to an embodiment of the present application;

[31] FIG. 3 is another specific implement flowchart of step S102 of a risk prediction method according to an embodiment of the present application;

[32] FIG. 4 shows a micro-expression fraud probability model trained by a risk prediction method according to an embodiment of the present application;

[33] FIG. 5 is a specific implement flowchart of step S104 of a risk prediction method according to an embodiment of the present application;

[34] FIG. 6 is a structural diagram of a risk prediction apparatus according to an embodiment of the present application;

[35] FIG. 7 is a structural diagram of a risk prediction apparatus according to another embodiment of the present application; and

[36] FIG. 8 is a schematic diagram of a server according to an embodiment of the present application.

DESCRIPTION OF EMBODIMENTS

[37] In order to make the objectives, features and advantages of the present application more obvious and understandable, technical solutions in the embodiments of the present application are described below with reference to accompanying diagrams. The embodiments described below are only part of rather than all embodiments of the present application. All other embodiments obtained by ordinary persons having skills in the art based on the embodiments of the present application without creative efforts are within the protective scope of the present application.

[38]Embodiment 1:

[39]FIG. 1 illustrates an implementing process of a risk prediction method according to an embodiment of the present application, and the method includes steps S101 to S104. The specific implementation principles of each step are as follows:

[40]Step S101, obtaining a video image of an applicant during an interview.

[41]In the embodiment of the present application, in the process of the applicant's interview, the applicant's expression during the interview and especially the facial expression of the applicant are photographed by a camera. Therefore, the video image includes the applicant's expression image. Practically, many of the applicant's expressions, namely micro-expressions, flash by. The micro-expression is a very fast expression with a duration of only 1/25 to 1/5 seconds, which is a short and uncontrollable facial expression showed when people try to suppress or hide their true emotions. In the embodiment of the present application, when the applicant answers a question, most of the time, the applicant is expressionless or shows other common expressions, while useful information often appears only in those micro-expressions that may flash by. Therefore, through the video recording of the applicant's performance during the interview, the user's micro-expressions are analyzed to avoid missing micro-expressions that may appear and improve the accuracy of risk prediction.

[42]Further, since the applicant may answer more than one question during the interview, the complete video image in the interview may be divided into a plurality of video images according to the duration of a question and the answer, and the plurality of obtained video images are subjected to micro-expression analysis respectively, that is, the video image during the interview is divided into a plurality of sub-video images by content or by duration.

[43]Step S102, clustering video frames in the video image to determine a key frame video image.

[44]Useful information often only appears in micro-expressions that may flash by. In a video image, the statistic of the duration for the expressions has significant impact on analysis of the expression. Therefore, by determining the key frame video image in the video image and eliminating redundant frame images, the influence of video duration on micro-expression analysis can be eliminated. In the embodiment of the present application, video frames in the video image are clustered to determine a key frame video image, thereby avoiding the analysis of each frame of video image and improving the efficiency of analysis.

[45]Specifically, in the embodiment of the present application, clustering is performed according to facial expressions in video frames. The principle of clustering includes: the facial expressions in the

video frame images tend to be similar to each other in a certain sense (higher similarity); and different facial expressions tend to be dissimilar (lower similarity). Whether the similarity is higher or lower is determined by a comparison with a set similarity threshold. If the similarity is not lower than the preset similarity threshold, it is considered that the similarity is higher and the facial expressions tend to be similar to each other; and if the similarity is lower than the preset similarity threshold, it is considered that the similarity is lower and the facial expressions tend to be dissimilar to each other.

[46] As an embodiment of the present application, as shown in FIG. 2, the foregoing step S102 specifically includes:

[47] A1, selecting a specified number of video frames from the video image as an initial clustering center.

[48] A2, calculating the similarity between a video frame in the video image and the initial clustering center. Specifically, the similarity between the facial expression in the video frame and the facial expression in the video frame as the initial clustering center is calculated.

[49] A3, clustering video frames in the video image according to the calculated similarity and a preset minimum similarity. Specifically, if the calculated similarity is not less than the preset minimum similarity, the video frame is clustered with the initial clustering center. In contrast, if the calculated similarity is less than the preset minimum similarity, no clustering is performed. Further, all the video frames with the calculated similarities less than the preset similarity are separately clustered into one cluster.

[50] A4, reselecting a clustering center from the clustered video frames, and repeating the clustering until the clustering center converges. The clustering center convergence means that the video frame image as the clustering center is no longer modified. Specifically, each video frame image is marked with a timestamp, and whether the clustering center converges can be determined by determining whether the timestamp of the video frame image as the clustering center changes. If the timestamp as the video frame image has not changed, it is considered that the clustering center has converged, and if the timestamp of the video frame image is changed, it is considered that the clustering center has not converged yet.

[51] A5, determining the final clustering center as the key frame video image of the video image.

[52] In the embodiment of the present application, by clustering video frames in the video image to determine a key frame video image, the redundant video frames are eliminated to improve the efficiency of image analysis.

[53]As an embodiment of the present application, as shown in FIG. 3, a human facial action unit is included in each frame of video image. Therefore, the foregoing step S102 specifically includes:

[54]B1, obtaining an intensity value of the human facial action unit in each frame of video image according to the video frame in the video image.

[55]B2, classifying the video frame images according to the intensity value of the human facial action unit, and determining a key frame video image according to the classification result.

[56]Specifically, in order to objectively describe the facial expression of the applicant, a set of codes is used to describe the expression, and each code is called an action unit. The human facial expression is represented by a series of action units, an action unit number mapping table is established, and each action unit is represented by a predetermined number. For example, a surprised expression includes the raising of the inner sides of the eyebrows, the raising of the outer sides of the eyebrows, the raising of the upper eyelids, and the opening of the lower jaw. According to the action unit number mapping table, the action unit numbers corresponding to these actions are 1, 2, 6, and 18, respectively. This set of codes describes the surprised expression. The action unit identification can objectively describe the human facial action, and can also be used to analyze the emotional state corresponding to the expression. The action unit standard is considered to be standard only when the intensity value of the action unit is not less than the preset intensity threshold. Specifically, a facial expression includes a plurality of action units. When the intensity values of the specified action units are not less than the preset intensity threshold, it is determined that the plurality of action units correspond to the expression. The intensity value of the action unit can be expressed by the amplitude of the activity of the facial organs. For example, the intensity value of the action unit is determined by the difference between the amplitude of the lower jaw opening and the preset amplitude threshold. Further, in the same facial expression, more than one action unit may be included. For example, in a surprised expression, the intensity value of each action unit is determined by respectively differences between the corresponding preset amplitude threshold and the amplitudes of a series of facial organs such as the raising of the inner sides of the eyebrows, the raising of the outer sides of the eyebrows, the raising of the upper eyelids, and the opening of the lower jaw. The intensity value of the set of action units is determined according to the sum of the intensity values of the action units to determine the facial expression corresponding to the set of action units.

[57]In the embodiment of the present application, the facial expressions corresponding to the human facial action units with the intensity value difference within the preset difference range are also very similar. Therefore, the video frame images are classified according to the intensity value

of the human facial action unit, and a key frame video image is determined based on the classification result, to eliminate redundant video frames.

[58]Further, according to the intensity of the human facial action unit in each frame of image, all the video frames in the video image are clustered, a set number of video frames are randomly extracted as initial clustering centers (for example, if there are 7 clustering centers, 7 video frame images are selected), and a key frame image is screened according to the preset intensity threshold of the action unit obtained by the statistical result in advance. For example, for a video frame image, it is considered that the image is a key frame video image only when the intensity values of the specified facial action units are not less than the preset intensity threshold and the difference between the intensity value of the facial action unit of the video frame image and the intensity value of the clustering center is not less than the preset intensity difference.

[59]Step S103, determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model.

[60]In the embodiment of the present application, the micro-expression fraud probability model is used to acquire a fraud probability of a micro-expression in the key frame video image, and the micro-expression fraud probability model is pre-trained, and machine learning may be adopted to train the micro-expression fraud probability model.

[61]In an embodiment of the present application, FIG. 4 is a specific implement flowchart of a micro-expression fraud probability model trained by a risk prediction method according to an embodiment of the present application, which is described in detail as follows:

[62]C1, acquiring a set number of labeled sample videos, the labels including fraud and non-fraud. Since the labels including fraud and non-fraud are attached to the sample videos, the label which is the same as the label of the sample video is attached to each video frame image in the sample video.

[63]C2, extracting a sample key frame image in each sample video, the label of the sample key frame image being the same as the label which belongs to the sample video.

[64]C3, taking the extracted sample key frame image as a training sample to train a support vector machine (SVM) classifier, and determining the trained SVM classifier as a micro-expression fraud probability model. The SVM classifier is a support vector machine, and is a common determination method. In the field of machine learning, the SVM classifier is a supervised learning model that is commonly used for pattern recognition, classification, and regression analysis.

[65] Specifically, the sample key frame image of each sample video is extracted according to a K-means clustering algorithm, the intensity of the action unit in the sample key frame image is determined, and the sample key frame image is used as a training sample to train the SVM classifier, where a data point is a sample key frame image, characterized by the intensity value of the facial action unit, the label is fraud or non-fraud, and optimal parameters of the SVM classifier are determined through repeated training, thereby generating a micro-expression fraud probability model.

[66] In the embodiment of the present application, the SVM classifier is used to train the sample key frame image to generate a micro-expression fraud probability model, and then the determined key frame video image is input to the micro-expression fraud probability model to determine the fraud probability of the micro-expression corresponding to the key frame video image.

[67] Illustratively, a hyperplane is trained by the SVM classifier, and a facial expression action unit is a point in a feature space, and the action unit intensity value of the face expression in an image as input point. The distance between the point and the hyperplane of the SVM classifier is determined, the distance is input into a sigmoid function to obtain a probability value, and the sigmoid function is expressed as: $S(x)=1/(1+e^{-x})$, where x represents the distance from the point represented by the action unit to the hyperplane trained by the SVM. If the probability value is greater than 50%, it is determined that the key frame image is fraudulent, and if the probability value is not greater than 50%, it is determined that the key frame image is not fraudulent.

[68] In the embodiment of the present application, a probability value can be obtained each time a video image is input into the micro-expression fraud probability model. If the fraud probability of the key frame video image is greater than the preset probability threshold, it is determined that the micro-expression in the key frame video image is a fraud expression, and if the fraud probability of the key frame video image is not greater than the preset probability threshold, it is determined that the micro-expression in the key frame video image is a non-fraud expression. In general, the preset probability threshold is set to 50%.

[69] There may be more than one video image for the same applicant during the interview. For the same video image, more than one key frame video image can be determined. The plurality of key frames (video image) of the video image are sequentially input into the micro-expression fraud probability model to obtain the probability values respectively, and then the probability values of the plurality of key frame images are averaged. The average value is determined as the fraud probability of the video image. Therefore, whether the video image is fraudulent is determined according to the comparison result of the fraud probability and the preset probability threshold.

[70] Step S104, performing risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

[71] In the embodiment of the present application, according to the fraud probability of the micro-expression corresponding to the key frame video image, the applicant's integrity reliability can be determined, and the integrity reliability is inversely proportional to the reliability of the fraud probability. The higher the fraud probability is, the lower the integrity reliability is. The integrity reliability is also inversely proportional to the repayment risk. The lower the integrity reliability is, the higher the repayment risk is.

[72] In an embodiment of the present application, FIG. 5 illustrates a specific implementing process of step S104 of a risk prediction method according to an embodiment of the present application, which is described in detail as follows:

[73] D1, comparing the fraud probability of the micro-expression corresponding to the key frame video image with a preset risk probability threshold.

[74] D2, predicting that the applicant's repayment risk exceeds a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is not less than the preset risk probability threshold.

[75] D3, predicting that the applicant's repayment risk is within a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is less than the preset risk probability threshold.

[76] Specifically, the preset risk probability threshold is used as a critical point to predict whether the applicant's repayment risk exceeds a preset risk range. Further, the difference between the fraud probability and the preset risk probability threshold is calculated and the level of the applicant's repayment risk is determined according to a pre-established difference level comparison table.

[77] Optionally, in an embodiment of the present application, step S104 further includes:

[78] D4, if it is predicted that the applicant's repayment risk exceeds the preset risk range, proposing the risk prevention and control measures.

[79] Specifically, if it is predicted that the applicant's repayment risk exceeds the preset risk range, the measures in a measure library established according to historical audit information, which match the applicant's repayment risk, are taken, to provide suggestions for an auditor.

[80] In the embodiments of the present application, by acquiring a video image of an applicant during the interview, video frames in the video image are clustered. Clustering is performed

according to the similarity between facial expressions in the video frames to determine a key frame video image, or clustering is performed according to the intensity value of a human facial action unit in the video frame to determine a key frame video image; then a fraud probability of a micro-expression corresponding to the key frame video image is determined according to the determined key frame video image and a micro-expression fraud probability model, and finally risk prediction of the applicant's repayment ability is performed according to the determined fraud probability of the micro-expression corresponding to the key frame video image. In the solution, by analyzing the micro-expression of the applicant during the interview, the applicant's fraud probability is evaluated, the integrity reliability of the applicant is determined according to the comparison result between the fraud probability and the preset risk probability threshold, and the risk prediction is performed on the applicant's repayment ability according to the integrity reliability, which provides objective auxiliary measures for predicting and evaluating the applicant's repayment ability, thereby improving the accuracy of risk prediction and the efficiency of prediction.

[81] It should be understood that the size of the serial numbers of the steps in the above embodiments does not mean the order of execution. The order of execution of each process should be determined by its function and internal logic, and should not be construed as limiting the implementation process of the embodiments of the present application.

[82] Embodiment 2:

[83] Corresponding to the risk prediction method of the above embodiment, FIG. 6 illustrates a structural block diagram of a risk prediction apparatus according to an embodiment of the present application. For convenience in description, only related parts of the embodiment of the present application are shown.

[84] Referring to FIG. 6, the risk prediction apparatus includes: a video image acquisition module 61, a key image determination module 62, a fraud probability determination module 63, and a risk prediction module 64, where:

[85] the video image acquisition module 61 is configured to obtain a video image of an applicant during an interview;

[86] the key image determination module 62 is configured to cluster video frames in the video image to determine a key frame video image;

[87] the fraud probability determination module 63 is configured to determine a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and

[88]the risk prediction module 64 is configured to perform risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

[89]Optionally, the key image determination module 62 includes:

[90]a center determination submodule, configured to select a specified number of video frames from the video image as an initial clustering center;

[91]a similarity calculation submodule, configured to calculate the similarity between a video frame in the video image and the initial clustering center;

[92]a clustering submodule, configured to cluster video frames in the video image according to the calculated similarity and a preset minimum similarity;

[93]where the clustering submodule is also configured to reselect a clustering center from the clustered video frames, and repeat the clustering until the clustering center converges; and

[94]a first image determination submodule, configured to determine the final clustering center as the key frame video image of the video image.

[95]Optionally, the key image determination module 62 includes:

[96]an intensity value determination submodule, configured to obtain an intensity value of the human facial action unit in each frame of video image according to the video frame in the video image; and

[97]a second image determination submodule, configured to classify the video frame image according to the intensity value of the human facial action unit, and determine a key frame video image according to the classification result.

[98]Optionally, the risk prediction module 64 includes:

[99]a probability comparison submodule, configured to compare the fraud probability of the micro-expression corresponding to the key frame video image with a preset risk probability threshold;

[100] a first prediction submodule, configured to predict that the applicant's repayment risk exceeds a preset risk range if the fraud probability of the micro-expression corresponding to the key frame video image is not less than the preset risk probability threshold; and

[101] a second prediction submodule, configured to predict that the applicant's repayment risk is within a preset risk range if the fraud probability of the micro-expression corresponding to the key frame video image is less than the preset risk probability threshold.

[102] Optionally, as shown in FIG. 7, the risk prediction apparatus further includes:

[103] a sample video acquisition module 71, configured to acquire a set number of labeled sample videos, where the labels include fraud and non-fraud;

[104] a key image extraction module 72, configured to extract a sample key frame image in each sample video, the label of the sample key frame image being the same as the label which belongs to the sample video; and

[105] a classification training module 73, configured to take the extracted sample key frame image as a training sample to train an SVM classifier, and determine the trained SVM classifier as a micro-expression fraud probability model.

[106] In the embodiments of the present application, by acquiring a video image of an applicant during the interview, video frames in the video image are clustered to determine a key frame video image, then a fraud probability of a micro-expression corresponding to the key frame video image is determined according to the determined key frame video image and a micro-expression fraud probability model, and finally risk prediction of the applicant's repayment ability is performed according to the determined fraud probability of the micro-expression corresponding to the key frame video image. In the solution, by analyzing the micro-expression of the applicant during the interview, the applicant's fraud probability is evaluated, and the risk prediction is performed on the applicant's repayment ability according to the fraud probability, which provides objective auxiliary measures for predicting and evaluating the applicant's repayment ability, thereby improving the accuracy of risk prediction and the efficiency of prediction.

[107] Embodiment 3:

[108] FIG. 8 is a schematic diagram of a server according to an embodiment of the present application. As shown in FIG. 8, the server 8 of this embodiment includes a processor 80, a storage 81 and computer readable instructions 82 stored in the storage 81 and executable on the processor 80, such as a risk prediction program. When the processor 80 executes the computer readable instructions 82, the steps in each foregoing embodiment of the risk prediction method, such as steps 101 to 104 shown in FIG. 1, are implemented. Alternatively, when the processor 80 implements the computer readable instructions 82, functions of each module/unit in the various apparatus

embodiments described above, such as the functions of the modules 61 to 64 shown in FIG. 6, are implemented.

[109] Illustratively, the computer readable instructions 82 can be partitioned into one or more modules/units that are stored in the storage 81 and executed by the processor 80, to complete the present application. The one or more modules/units may be a series of computer readable instruction segments capable of performing a particular function, and the instruction segments are used for describing the execution process of the computer readable instructions 82 in the server 8.

[110] The server 8 may be a computing device such as a desktop, a notebook, a palmtop computer, and a cloud server. The server may include, but is not limited to, the processor 80, and the storage 81. A person skilled in the art may understand that FIG. 8 is merely an example of the server 8 and does not constitute a limitation on the server 8, and may include more or fewer components than those illustrated, or combine some components, or different components. For example, the server may further include an input/output device, a network access device, a bus, and the like.

[111] The processor 80 may be a central processing unit (CPU), or may be other general-purpose processors, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic devices, discrete gates or transistor logic devices, discrete hardware components, and the like. The general purpose processor may be a microprocessor or the processor or any conventional processor or the like.

[112] The storage 81 may be an internal storage unit of the server 8, such as a hard disk or a storage of the server 8. The storage 81 may also be an external storage device of the server 8, such as, a plug-in hard disk disposed on the server 8, a smart memory card (SMC), a secure digital (SD) card, and a flash card. Further, the storage 81 may also include both an internal storage unit and an external storage device of the server 8. The storage 81 is configured to store the computer readable instructions and other programs and data required by the server. The storage 81 may also be used to temporarily store data that has been output or is about to be output.

[113] In addition, each functional unit in each embodiment of the present application may be integrated into one processing unit, or each unit may exist physically separately, or two or more units may be integrated into one unit. The above integrated unit can be implemented in the form of hardware or in the form of a software functional unit.

[114] The computer readable storage medium may include any entity or device capable of carrying the computer readable instruction, a recording medium, a universal serial bus (USB) flash

disk, a mobile hard disk, a magnetic disk, an optical disk, a computer memory, a read-only memory (ROM), a random access memory (RAM), electrical carrier signals, telecommunications signals, software distribution media, and the like. It should be noted that the content contained in the computer readable storage medium may be appropriately increased or decreased according to the requirements of legislation and patent practice in a jurisdiction. For example, in some jurisdictions, according to legislation and patent practice, the computer readable storage medium does not include electrical carrier signals and telecommunication signals.

[115] The above embodiments are only used to illustrate the technical solutions of the present application, and are not intended to limit the technical solutions; although the present application has been described in detail with reference to the foregoing embodiments, ordinary persons having skills in the art should understand that they can still modify the technical solutions recorded in each aforementioned embodiment, or perform equivalent substitutions on some of the technical features therein; and such modifications or substitutions do not make the essence of the corresponding technical solution depart from the spirit and scope of the technical solution of each embodiment of the present application, and should be included in the scope of protection of the present application.

CLAIMS

1. A risk prediction method, comprising:
 - obtaining a video image of an applicant during an interview;
 - clustering video frames in the video image to determine a key frame video image;
 - determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and
 - performing risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.
2. The method according to claim 1, wherein the step of clustering video frames in the video image to determine the key frame video image comprises:
 - selecting a specified number of video frames from the video image as an initial clustering center;
 - calculating the similarity between a video frame in the video image and the initial clustering center;
 - clustering video frames in the video image according to the calculated similarity and a preset minimum similarity;
 - reselecting a clustering center from the clustered video frames, and repeating the clustering until the clustering center converges; and
 - determining the final clustering center as the key frame video image of the video image.
3. The method according to claim 1, wherein the step of clustering video frames in the video image to determine the key frame video image comprises:
 - obtaining an intensity value of a human facial action unit in each frame of video image according to the video frame in the video image;
 - classifying the video frame images according to the intensity value of the human facial action unit, and determining a key frame video image according to the classification result.

4. The method according to claim 1, wherein before the step of determining the fraud probability of the micro-expression corresponding to the key frame video image according to the determined key frame video image and the micro-expression fraud probability model, the method comprises:

acquiring a set number of labeled sample videos, the labels comprising fraud and non-fraud;

extracting a sample key frame image in each sample video, the label of the sample key frame image being the same as the label which belongs to the sample video;

taking the extracted sample key frame image as a training sample to train a support vector machine (SVM) classifier, and determining the trained SVM classifier as a micro-expression fraud probability model.

5. The method according to any one of claims 1 to 4, wherein the step of performing risk prediction according to the determined fraud probability of the micro-expression corresponding to the key frame video image comprises:

comparing the fraud probability of the micro-expression corresponding to the key frame video image with a preset risk probability threshold;

predicting that the applicant's repayment risk exceeds a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is not less than the preset risk probability threshold; and

predicting that the applicant's repayment risk is within a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is less than the preset risk probability threshold.

6. A risk prediction apparatus, comprising:

a video image acquisition module, configured to obtain a video image of an applicant during an interview;

a key image determination module, configured to cluster video frames in the video image to determine a key frame video image;

a fraud probability determination module, configured to determine a fraud probability of a

micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and

a risk prediction module, configured to perform risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

7. The risk prediction apparatus according to claim 6, wherein the key image determination module comprises:

a center determination submodule, configured to select a specified number of video frames from the video image as an initial clustering center;

a similarity calculation submodule, configured to calculate the similarity between a video frame in the video image and the initial clustering center;

a clustering submodule, configured to cluster video frames in the video image according to the calculated similarity and a preset minimum similarity;

wherein the clustering submodule is also configured to reselect a clustering center from the clustered video frames, and repeat the clustering until the clustering center converges; and

a first image determination submodule, configured to determine the final clustering center as the key frame video image of the video image.

8. The risk prediction apparatus according to claim 6, wherein the key image determination module comprises:

an intensity value determination submodule, configured to obtain an intensity value of the human facial action unit in each frame of video image according to the video frame in the video image; and

a second image determination submodule, configured to classify the video frame image according to the intensity value of the human facial action unit, and determine a key frame video image according to the classification result.

9. The risk prediction apparatus according to claim 6, wherein the risk prediction apparatus further comprises:

a sample video acquisition module, configured to acquire a set number of labeled sample videos, the labels comprising fraud and non-fraud;

a key image extraction module, configured to extract a sample key frame image in each sample video, the label of the sample key frame image being the same as the label which belongs to the sample video; and

a classification training module, configured to take the extracted sample key frame image as a training sample to train an SVM classifier, and determine the trained SVM classifier as a micro-expression fraud probability model.

10. The risk prediction apparatus according to any one of claims 6 to 9, wherein the risk prediction module comprises:

a probability comparison submodule, configured to compare the fraud probability of the micro-expression corresponding to the key frame video image with a preset risk probability threshold;

a first prediction submodule, configured to predict that the applicant's repayment risk exceeds a preset risk range if the fraud probability of the micro-expression corresponding to the key frame video image is not less than the preset risk probability threshold; and

a second prediction submodule, configured to predict that the applicant's repayment risk is within a preset risk range if the fraud probability of the micro-expression corresponding to the key frame video image is less than the preset risk probability threshold.

11. A computer readable storage medium which stores computer readable instructions, wherein when the computer readable instructions are executed by a processor, the following steps are implemented:

obtaining a video image of an applicant during an interview;

clustering video frames in the video image to determine a key frame video image;

determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and

performing risk prediction of the applicant's repayment ability according to the determined

fraud probability of the micro-expression corresponding to the key frame video image.

12. The computer readable storage medium according to claim 11, wherein the step of clustering video frames in the video image to determine the key frame video image comprises:

selecting a specified number of video frames from the video image as an initial clustering center;

calculating the similarity between a video frame in the video image and the initial clustering center;

clustering video frames in the video image according to the calculated similarity and a preset minimum similarity;

reselecting a clustering center from the clustered video frames, and repeating the clustering until the clustering center converges; and

determining the final clustering center as the key frame video image of the video image.

13. The computer readable storage medium according to claim 11, wherein the step of clustering video frames in the video image to determine the key frame video image comprises:

obtaining an intensity value of a human facial action unit in each frame of video image according to the video frame in the video image;

classifying the video frame images according to the intensity value of the human facial action unit, and determining a key frame video image according to the classification result.

14. The computer readable storage medium according to claim 11, wherein before the step of determining the fraud probability of the micro-expression corresponding to the key frame video image according to the determined key frame video image and the micro-expression fraud probability model, the method comprises:

acquiring a set number of labeled sample videos, the labels comprising fraud and non-fraud;

extracting a sample key frame image in each sample video, the label of the sample key frame image being the same as the label which belongs to the sample video;

taking the extracted sample key frame image as a training sample to train a support vector machine (SVM) classifier, and determining the trained SVM classifier as a micro-expression fraud probability model.

15. The computer readable storage medium according to any one of claims 11 to 14, wherein the step of performing risk prediction according to the determined fraud probability of the micro-expression corresponding to the key frame video image comprises:

comparing the fraud probability of the micro-expression corresponding to the key frame video image with a preset risk probability threshold;

predicting that the applicant's repayment risk exceeds a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is not less than the preset risk probability threshold; and

predicting that the applicant's repayment risk is within a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is less than the preset risk probability threshold.

16. A server, comprising a storage, a processor, and computer readable instructions stored in the storage and executable on the processor, wherein the processor implements the following steps when executing the computer readable instructions:

obtaining a video image of an applicant during an interview;

clustering video frames in the video image to determine a key frame video image;

determining a fraud probability of a micro-expression corresponding to the key frame video image according to the determined key frame video image and a micro-expression fraud probability model; and

performing risk prediction of the applicant's repayment ability according to the determined fraud probability of the micro-expression corresponding to the key frame video image.

17. The server according to claim 16, wherein the step of clustering video frames in the video image to determine the key frame video image comprises:

selecting a specified number of video frames from the video image as an initial clustering

center;

calculating the similarity between a video frame in the video image and the initial clustering center;

clustering video frames in the video image according to the calculated similarity and a preset minimum similarity;

reselecting a clustering center from the clustered video frames, and repeating the clustering until the clustering center converges; and

determining the final clustering center as the key frame video image of the video image.

18. The server according to claim 16, wherein the step of clustering video frames in the video image to determine the key frame video image comprises:

obtaining an intensity value of a human facial action unit in each frame of video image according to the video frame in the video image;

classifying the video frame images according to the intensity value of the human facial action unit, and determining a key frame video image according to the classification result.

19. The server according to claim 16, wherein before the step of determining the fraud probability of the micro-expression corresponding to the key frame video image according to the determined key frame video image and the micro-expression fraud probability model, the method comprises:

acquiring a set number of labeled sample videos, the labels comprising fraud and non-fraud;

extracting a sample key frame image in each sample video, the label of the sample key frame image being the same as the label which belongs to the sample video;

taking the extracted sample key frame image as a training sample to train a support vector machine (SVM) classifier, and determining the trained SVM classifier as a micro-expression fraud probability model.

20. The server according to any one of claims 16 to 19, wherein the step of performing risk

prediction according to the determined fraud probability of the micro-expression corresponding to the key frame video image comprises:

comparing the fraud probability of the micro-expression corresponding to the key frame video image with a preset risk probability threshold;

predicting that the applicant's repayment risk exceeds a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is not less than the preset risk probability threshold; and

predicting that the applicant's repayment risk is within a preset risk range, if the fraud probability of the micro-expression corresponding to the key frame video image is less than the preset risk probability threshold.