

A METHOD, A DEVICE AND A COMPUTER-READABLE STORAGE MEDIUM FOR FACE FRONTALIZATION

TECHNICAL FIELD

[0001] The present invention relates to the field of face recognition, in particular to a camera system and a method, a device, a chip and a computer-readable storage medium for face frontalization.

BACKGROUND

[0002] In view of the fact that significant progresses have been made in recent years in the development of face recognition technology, as one of the important research topics in the field of artificial intelligence and machine vision, by virtue of the rapid development of and continuous breakthroughs made in artificial intelligence technology and energy-related technologies, face recognition technology is widely applied in industrial fields such as security protection, transportation, finance and medical treatment and therefore presents broad market prospects.

[0003] Face recognition technology involves such two segments as face detection and face recognition. Face detection technology performs face detection in images or videos using target detection technology, and crops and further recognizes the detected face. Face recognition technology extracts the features of face images using deep learning algorithms and represents face features in the form of feature vectors, indicating that the similarity of feature vectors of two faces determines the similarity of the two faces.

[0004] As the clarity and completeness of face image will directly affect the result of face recognition, the face images collected are mostly side views in many uncontrollable environments. Compared with frontal face images, side images show facial features that are inaccurate to a great extent and that are incomplete, leading to unsatisfactory face recognition result in practical applications. Moreover, the detection method in the prior art cannot achieve a more accurate face recognition based on side face images.

SUMMARY

[0005] In order to solve the problems in the prior art, at least one embodiment of the present invention provides a method, a device, a chip and a computer-readable storage medium for face frontalization, which can frontalize side face images to frontal ones and therefore tackle the problems mentioned in the section Background above.

[0006] First of all, embodiments of the present invention propose a face frontalization method which is applied to: detect pictures to be recognized and extract face image from the pictures to be recognized, determine whether the face image extracted is a frontal or side image, detect key points of the face image extracted and form a key points image based on the key points detected if it is a side one, form a key points image for frontal image based on the key points image for the side image, and form a frontal face image based on the key points image for frontal image.

[0007] In some embodiments, the formation of key points image for frontal image based on the key points image for side image includes: migrating locations of key points in the key points image for side image to obtain key points in frontal image; and, forming the key points image for frontal image based on the key points in frontal image.

[0008] In some embodiments, the location migration of key points involves multiple location migrations of key points, and the formation of key points image for frontal image based on the key points image for side image includes: migrating locations of key points in the key points image for side image to obtain key points in face image in the intermediate pose, and forming a key points image for the face image in the intermediate pose with the face angle corresponding to the intermediate pose being between the side face image and the frontal face image; migrating locations of key points in the key points image for the face image in the intermediate pose to obtain key points in frontal face image, and forming a key points image for the frontal image.

[0009] In some embodiments, the location migration of key points in key points image specifically includes: determining the vicinity of the key points according to preset rules; and migrating locations of key points and their vicinity.

[0010] In some embodiments, the location migration of key points in key points image

specifically includes: migrating locations of key points by means of pose transfer networks.

[0011] In some embodiments, the face frontalization method also includes: performing face recognition according to the frontal face image formed.

[0012] Secondly, embodiments of the present invention also provide a face frontalization device, which comprises of: a detection module designed to detect pictures to be recognized and obtain face images from the pictures to be recognized; a side face recognition module designed to determine whether the face image obtained is a frontal or side image; a key point detection module designed to detect key points in the side image recognized by the side face recognition module; a key point location migration module designed to migrate locations of key points detected in the side image to obtain key points of frontal image; a frontal face image generation module designed to form a key points image for frontal image based on the key points in frontal image and form a frontal image based on the key points image for frontal image.

[0013] In some embodiments, the key point location migration module is a pose transfer network.

[0014] In some embodiments, the pose transfer network is a progressive pose attention transfer network, and the progressive pose attention transfer network consists of multiple cascaded pose attention transfer sub-networks.

[0015] In some embodiments, the multiple cascaded pose attention transfer sub-networks include a first pose attention transfer sub-network and a second pose attention transfer sub-network. The first pose attention transfer sub-network is used to migrate locations of key points in the key points image for side image to obtain key points of face image in the intermediate pose, with the face angle corresponding to the intermediate pose being between the side face image and the frontal face image. The second pose attention transfer sub-network is used to migrate locations of key points in the key points image for face image in the intermediate pose to obtain a key points image for frontal image.

[0016] In some embodiments, the device also includes a first determination module designed to determine the vicinity of the key points according to preset rules; and the

key point location migration module is used to migrate locations of key points and their vicinity.

[0017] In some embodiments, the device also includes a face recognition module designed to perform face recognition on the frontal face image generated by the frontal face image generation module.

[0018] Thirdly, embodiments of the present invention also provide a computer device which comprises of at least a processor, a memory, a communication interface and a communication bus, which processor, memory and communication interface maintain communication with each other through the communication bus; and also comprises of a memory coupled to the at least one processor, which memory stores executable instructions that make it possible to realize the method mentioned in the first aspect above when executed by the at least a processor.

[0019] Fourthly, embodiments of the present invention also provide a chip designed to perform the method mentioned in the first aspect above. Specifically, the chip is designed with a processor which is used to call and run any computer program from the memory and therefore make it possible for any device installed with the chip to perform the method mentioned in the first aspect above.

[0020] Fifthly, embodiments of the present invention also provide a computer-readable storage medium which stores computer programs that make it possible to realize the method mentioned in the first aspects above when executed by processor.

[0021] Finally, embodiments of the present invention also provide a computer program product which contains a computer program instruction directing the computer to perform the method mentioned in the first aspect above.

[0022] In summary, the face frontalization method and device mentioned in embodiments of the present invention, helping to improve the accuracy of face recognition in practical applications, work in the following steps: detect and measure key points in the target image; form a key points image for frontal face image based on the key points image for side face image to obtain the frontal face image with frontalized pose; improve facial features; and finally frontalize side face image to frontal one.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] In order to give a clearer explanation on the technical solutions mentioned in the embodiments of the present invention, the drawings to be used in the embodiments or the description of the prior art are briefly introduced as below. Obviously, the drawings described below are only some embodiments of the present invention. Those of ordinary skill in the art also have an access to other drawings based on the following drawings without creative labor.

[0024] FIG. 1 is a flowchart of a specific embodiment concerning the face frontalization method proposed in the present invention;

[0025] FIG. 2 is a flowchart of another specific embodiment concerning the face frontalization method proposed in the present invention;

[0026] FIG. 3 is a structure diagram of a specific embodiment concerning the face frontalization device provided in the present invention;

[0027] FIG. 4 is a structure diagram of another specific embodiment concerning the face frontalization device provided in the present invention;

[0028] FIG. 5 is a basic structure diagram of the computer device in the embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0029] A detailed description is made on the present application as follows with reference to the drawings and specific embodiments, making it possible to have a clearer understanding of the purpose, features and advantages of the present application. It should be understood that all the information described below with reference to the drawings and specific embodiments is merely exemplary, and should not be construed as limiting the scope of protection of the present application. Unless the context clearly indicates otherwise, terms referring to the singular form, such as “a” and “said”, should include the plural. The terms such as “first” and “second” used in the present application may be used interchangeably to distinguish one or one type of component from another or another type of that, and are not intended to indicate the location or importance of the corresponding individual component.

[0030] Any reference herein to an “embodiment” means that specific features, structures, or characteristics described in connection with the embodiment may be included in at least one embodiment of the present application. The reference to the term in different places in the Specification does neither necessarily refer to the same embodiment, nor refer to any independent or alternative embodiment mutually exclusive of other embodiments. Those skilled in the art understand explicitly and implicitly that the embodiments described herein can be used combined with other embodiments.

[0031] The term “and/or” used herein merely describes three association relationships between associated objects. For instance, the phrase “A and/or B” may indicate three cases in which A exists alone, A and B exist simultaneously, and B exists alone. In addition, the character “/” used herein generally indicates an “or” relationship between the two associated objects placed before and after the character.

[0032] In order to enable those skilled in the art to have a better understanding of the solutions set out in the present application, a clear and complete description is made below in combination of the drawings attached on the technical solutions mentioned in the embodiments of the present application.

[0033] Due to the imbalance of face distribution, recognition performance of face recognition systems in terms of side face images is much worse than that in terms of frontal face images, in response to which a combination of face frontalization and face recognition is generally applied. The face frontalization methods available in the prior art mainly include 3D-mapping-based methods and deep-learning-based methods, of which the former maps 2D images onto the projected 3D shape models and then renders to frontal face images, and the latter generates frontal face images based on side face images using the GAN (Generative Adversarial Networks) method. And the inventor of the present application proposes a face frontalization method which is different from the prior art and can frontalize the side face images recognized to frontal face images.

[0034] First of all, FIG. 1 is a flowchart of a specific embodiment concerning the face frontalization method proposed in the present invention, and as shown in FIG. 1, the face frontalization method proposed in the present invention includes:

[0035] Step 110: Detect pictures to be recognized and obtain face images from the pictures to be recognized. Specifically, the methods available in the prior art may be applied by, for example, detecting pictures to be recognized using face recognition algorithms to extract face images from the pictures to be recognized. Specifically, face images may be accurately collected from the pictures to be recognized in uncontrolled environments by means of detection algorithms such as SSD (Single Shot Multibox Detector) algorithm, S3FD (Single Shot Scale-invariant Face Detector) algorithm and MTCNN (Multi-task Convolutional Neural Network) algorithm.

[0036] Step 120: Determine whether the face image extracted is a frontal or side image. For example, a convolutional neural network may be applied to construct a frontal and side images classifier and determine whether the face image extracted is a frontal or side image.

[0037] Step 130: Detect key points of the face image extracted, and form a key points image for the image based on the key points detected if the image is a side face image.

[0038] After the image extracted is determined to be a side image as described in Step 120, locate and detect key facial feature points (such as eyes, nose tip, corners of mouth, eyebrows, and contour points of other parts on the face) of the side image as key facial feature points of the side image, and form a key points image for the side image based on the key facial feature points detected. In particular, the following methods for detecting key points in face image may be adopted: traditional detection methods such as ASM (Active Shape Model) or AAM (Active Appearance Model), methods based on cascaded shape regression, and methods based on deep learning. And choice of the specific method to be applied is subject to no limitation in the present application.

[0039] Step 140: Form a key points image for frontal image based on the key points in side image. It can be understood that at this step, a frontal image is formed by means of location migration and based on side images available, as there is an angle difference between the side face pose and the frontal face pose shown in side image and frontal image respectively. For the convenience of clarification, side face pose and frontal face pose are called original pose and target pose respectively, based on which it can be said that the face image showing the original pose is converted into the face image showing

the target pose through location migration of key points. For example, if 15 key points are detected, the 15 key points detected in side images are used to form 15 key points for frontal face image by migrating locations of the key points by a certain angle. The number of key points in this embodiment is merely exemplary and may be more or less than the actual number. It can be understood that less information is contained and data is processed at a faster speed if key points are distributed sparsely, and on the contrary, the more information a face image contains, the slower the data processing speed may be. The number of key points may be determined as needed, which is not limited in the present application.

[0040] Step 150: Form a frontal face image based on the key points image for frontal image. At this step, the 15 key points of frontal face image that are obtained in Step 140 can be used to form a face image using the prior art, and the face image formed thereby is the frontal face image.

[0041] The face frontalization method mentioned in this embodiment forms a frontal face image by forming a key points image for frontal image based on the key points of side images, and therefore realizes the conversion of side face image into frontal face image in a way different from the prior art, improving the efficiency of face recognition in practical applications.

[0042] FIG. 2 is a flowchart of another specific embodiment concerning the face frontalization method proposed in the present invention. As shown in FIG. 2, the face frontalization method mentioned in the embodiments of the present invention includes the following steps:

[0043] Step 210: Detect pictures to be recognized and obtain face image from the pictures to be recognized, which may be done with reference to the steps set out in the embodiment shown in FIG. 1.

[0044] Step 220: Determine whether the face image extracted is a frontal or side image, which may be done with reference to the steps set out in the embodiment shown in FIG. 1.

[0045] Step 230: Detect key points of the face image extracted, and form a key points image for the image based on the key points detected if the image is a side face image,

which may be done with reference to the steps set out in the embodiment shown in FIG. 1.

[0046] Step 240: Determine the vicinity of the key points according to preset rules, and construct an area for each key point which covers the key point and may be a rectangular area of a preset size, a circular area of a preset radius or a preset area extending in a preset direction. In this way, in the subsequent steps, information on the vicinity of key points may also be extracted and more local information may be added, in addition to extracting information on key points.

[0047] Step 250: Migrate locations of key points and their vicinity in the key points image for side image to obtain key points of the face image in the intermediate pose. Extract feature information of 15 key points in the side image and migrate locations of the vicinity covering the key points to obtain key points of the face image in a preset intermediate pose as well as feature information of the vicinity of key points. Specifically, pose transfer networks may be used for pose migration.

[0048] The intermediate pose may be any pose between the original pose and the target pose. Specifically, the angle of the intermediate pose may be determined by calculating the angle of the original pose and the target pose and according to the times of migration required to gradually migrate the original pose to the target pose. For example, if the angle of side face image to the frontal face image is 60 degrees and the side image is gradually converted into a frontal image after 10 migrations, the angle of each migration is 6 degrees. All face poses in the process of migration can be called intermediate poses. It can be understood that under the same conditions, the more the number of migrations and the smaller the angle of each migration, the higher the accuracy of the final frontal face image.

[0049] Step 260: Migrate locations of key points and their vicinity of the face image in the intermediate pose to obtain key points of frontal face image, and form a key points image for frontal face image. At this step which continues from and is similar to Step 250, a key points image for frontal face image is finally obtained through migration.

[0050] Step 270: Form frontal face image based on the key points image for frontal image.

[0051] Besides, face recognition can also be performed on the frontal face images formed according to the above steps.

[0052] In this embodiment, a side face image may be gradually converted into a frontal face image after multiple location migrations of key points, which is not finished at once but is realized in a progressive way to ensure the higher accuracy of conversion. In addition, when each key point is migrated, the key point and its vicinity are migrated together, which can further retain local information near the key point and further improve the accuracy of face frontalization.

[0053] Secondly, FIG. 3 is a structure diagram of a specific embodiment concerning the face frontalization device provided in the present invention. As shown in FIG. 3, the face frontalization device comprises of a detection module 301, a side face recognition module 302, a key point detection module 303, a key point location migration module 304 and a frontal face image generation module 305. Specifically:

[0054] The detection module 301 is designed to detect pictures to be recognized and obtain face images from the pictures to be recognized;

[0055] The side face recognition module 302 is designed to determine whether the face image detected by the side face recognition module 302 is a frontal or side image;

[0056] The key point detection module 303 is designed to detect key points in the side image recognized by the side face recognition module;

[0057] The key point location migration module 304 is designed to migrate locations of key points detected in the side image to obtain key points of frontal image;

[0058] The frontal face image generation module 305 is designed to form a key points image for frontal image based on the key points in frontal image and form a frontal image based on the key points image for frontal image.

[0059] The modules included in the face frontalization device mentioned in this embodiment may be implemented with reference to the method mentioned in FIG. 1 to achieve the same technical effect. The face frontalization device mentioned in embodiments of the present invention, helping to improve the accuracy of face recognition in practical applications, works in the following steps: detect and measure key points in the target image; form a key points image for frontal face image based on

the key points image for side face image to obtain the frontal face image with frontalized pose; improve facial features; and finally frontalize side face image to frontal one.

[0060] FIG. 4 is a structure diagram of another specific embodiment concerning the face frontalization device provided in the present invention. As shown in FIG. 4, the face frontalization device comprises of a detection module 301, a side face recognition module 302, a key point detection module 303, a key point location migration module 304, a frontal face image generation module 305 and a face recognition module 306. Specifically:

[0061] The detection module 301 is designed to detect pictures to be recognized and obtain face images from the pictures to be recognized;

[0062] The side face recognition module 302 is designed to determine whether the face image detected by the side face recognition module 302 is a frontal or side image;

[0063] The key point detection module 303 is designed to detect key points in the side image recognized by the side face recognition module;

[0064] The key point location migration module 304 is designed to migrate locations of key points detected in the side image to obtain key points of frontal image. Specifically, the key point location migration module 304 may be a pose transfer network; the pose transfer network may be a progressive pose attention transfer network; and the progressive pose attention transfer network may consist of multiple cascaded pose attention transfer sub-networks, such as multiple cascaded pose-attention transfer blocks.

[0065] For example, the pose transfer network may comprise of a first pose attention transfer sub-network 3041 and a second pose attention transfer sub-network 3042, of which:

[0066] The first pose attention transfer sub-network 3041 is used to migrate locations of key points in the key points image for side image to obtain key points of face image in the intermediate pose, with the face angle corresponding to the intermediate pose being between the side face image and the frontal face image.

[0067] The second pose attention transfer sub-network 3042 is used to migrate locations

of key points in the key points image for face image in the intermediate pose to obtain a key points image for frontal image.

[0068] Furthermore, the pose transfer network may also include a first determination module designed to determine the vicinity of the key points according to preset rules. When the vicinity of key points is determined using the first determination module and when locations of key points are migrated using the key point location migration module, locations of key points and their vicinity may be migrated.

[0069] The frontal face image generation module 305 is designed to form a key points image for frontal image based on the key points in frontal image and form a frontal image based on the key points image for frontal image.

[0070] The face recognition module 306 is designed to perform face recognition on the frontal face image generated by the frontal face image generation module.

[0071] The specific technical details of the face frontalization device mentioned above are similar to those of the face frontalization method, and the technical effects that can be achieved in the embodiments of the face frontalization device can also be achieved in the embodiments of the face frontalization method, which is not described here to avoid repetition. Accordingly, the technical details mentioned in the embodiments of the face frontalization method can also be applied in the embodiments of the face frontalization device.

[0072] Thirdly, the embodiments of the present application further provide a computer device which may be a neural network server. For details, please refer to FIG. 5 which is a basic structure diagram of the computer device in the embodiment.

[0073] The computer device 5 comprises of a memory 51, a processor 52 and a network interface 53 that are communicatively connected to each other through a system bus. It should be pointed out that only the computer device 5 with the components 51-53 is shown in the figure. However, it should be understood that not all components shown are required to be implemented, and more or fewer components may be implemented instead. Those skilled in the art can understand that the computer device 5 mentioned here is a device that can automatically perform numerical calculation and/or information processing according to preset or stored instructions, and the device has its

hardware components including but not limited to microprocessors, Application Specific Integrated Circuits (ASICs), Field-Programmable Gate Arrays (FPGAs), Digital Signal Processors (DSPs), embedded units and so on.

[0074] The computer device 5 may be a desktop computer, a notebook, a palmtop computer, a cloud server or an otherwise computing device, and can realize human-computer interactions with users through a keyboard, a mouse, a remote control, a touchpad or a voice control device.

[0075] The memory 51 comprises of readable storage media of at least one kind, and can store executable instruction controllers, microcontrollers, microprocessors or other data processing chips, including readable storage media of at least one kind. The readable storage media includes non-volatile memories and volatile memories, e.g. flash memory, hard disk, multimedia card, card-type memory (such as SD or DX memory, etc.), random access memory (RAM), read-only memory (ROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), programmable read-only memory (PROM), magnetic memory, magnetic disk, optical disk, etc.; and the RAMs include static RAMs or dynamic RAMs. In some embodiments, the memory 51 may be an internal storage unit of the computer device 5, for example, a hard disk or a memory of the computer device 5. In other embodiments, the memory 51 may also be an external storage device of the computer device 5, for example, a plug-in hard disk, a smart memory card (SMC), a Secure Digital (SD), a flash card, etc. equipped on the computer device 5. Of course, the memory 51 may also include the internal storage unit and external storage device of the computer device 5. In this embodiment, the memory 51 is generally used to store operating system and application software installed on the computer device 5, such as program codes for performing face frontalization. In addition, the memory 51 may also be used to temporarily store various types of data that have been or will be outputted.

[0076] In the embodiments of the present application, the processor 52 may be a Central Processing Unit (CPU) or a Graphic Processing Unit (GPU), or may be other general-purpose processor, Digital Signal Processor (DSP), Application Specific Integrated Circuit (ASIC), Field-Programmable Gate Array (FPGA) or other programmable logic

device, discrete gate, transistor logic device or discrete hardware component. The general-purpose processor may be a microprocessor or any conventional processor, such as single-chip microcomputer.

[0077] The processor 52 is generally used to control the overall operation of the computer device 5. In this embodiment, the memory 51 is used to store program codes or instructions; the program codes include computer operation instructions; the processor 52 is used to execute the program codes or instructions stored in the memory 51 or to process data, for example, to execute the program codes for face frontalization.

[0078] The bus described herein may be an Industry Standard Architecture (ISA) bus, a Peripheral Component Interconnect (PCI) bus or an Extended Industry Standard Architecture (EISA) bus. The bus system may be divided into address bus, data bus, control bus and so on. For ease of representation, only one thick line is used to represent bus in the figure, which does not mean that there is only one bus or one type of bus.

[0079] Fourthly, the embodiments of the present invention also provide a chip for performing the method mentioned in the first aspect above. Specifically, the chip includes a processor which is configured to call and run any computer program from the memory and therefore make it possible for any device installed with the chip to perform the face frontalization method above.

[0080] Fifthly, the embodiments of the present invention also provide a computer-readable storage medium which may be a computer-readable signal medium or a computer-readable medium. The processor in computer reads the computer-readable program codes stored in the computer-readable medium, so that the processor can perform each step involved in the face frontalization method as shown in the Flow Chart 1 or each functional action involved in any combination of steps; and, generate a device that implements the functional actions specified in each block or any combination of blocks shown in the block diagram.

[0081] The computer-readable medium comprises of (but not limited to) electronic, magnetic, optical, electromagnetic or infrared memories or semiconductor systems, devices or units, or any appropriate combination of the foregoing. The memory is used to store program codes or instructions. The program codes include computer operation

instructions. And the processor is used to execute the program codes or instructions stored in the memory.

[0082] For the definitions of the memory and the processor, reference may be made to the description of the foregoing embodiments concerning computer device and no details are explained here. The computer-readable storage medium stores a computer program which makes it possible to implement the method mentioned in any paragraph in the first aspect above when executed by processor.

[0083] Finally, embodiments of the present invention also provide a computer program product comprising of a computer program instruction, which instruction instructs the computer to execute the method mentioned in the first aspect above.

[0084] Those skilled in the art can understand that the exemplary units and algorithm steps described in the embodiments disclosed herein may be implemented by electronic hardware or a combination of software and electronic hardware. Whether those functions are implemented by hardware or software depends on the specific application of technical solutions and design constraints. Those skilled in the art may implement the described functions for specific different applications in different ways, which should not be considered beyond the scope of the present application.

[0085] In the embodiments of the present application, the disclosed system, device and method may also be implemented in other ways. For example, the division of units is only a division of logical functions, and there may be other division methods in practice. For example, multiple units or components may be combined or may be integrated into another system. Besides, different units may be directly or indirectly coupled. In addition, the functional units in the embodiments of the present application may be integrated into one processing unit, or may exist physically and independently.

[0086] It should be understood that in the embodiments of the present application, the serial numbers of each process do not indicate the sequence in which those processes are executed, and the sequence in which those processes are executed should be determined by their respective functions and internal logics and should not constitute any limitation on the implementation of the embodiments of the present application.

[0087] If the functions aforesaid are implemented in the form of a software functional

unit and are sold or used as independent products, they may be stored in a machine-readable storage medium. Therefore, the technical solutions mentioned in the present application may be embodied in the form of a software product, which software product may be stored in a machine-readable storage medium and may include several instructions to enable the electronic device to perform all or part of the technical solutions described in the embodiments of the present application. The aforesaid storage medium may include various medias that can store program codes, such as ROM, RAM, removable disk, hard disk, magnetic disk or optical disk.

[0088] The above gives a detailed description of the implementation of the present application, but imposes no limitation on the protection scope of the present application. Those skilled in the art may make changes or replacements within the technical scope disclosed in the present application, provided that those changes or replacements shall fall within the protection scope of the present application.

Claims

WHAT IS CLAIMED IS:

1. A face frontalization method comprising:

detecting pictures to be recognized and extracting face image from the pictures to be recognized;

determining whether the face image extracted is a frontal or side image;

detecting key points of the face image extracted and forming a key points image based on the key points detected if it is a side image;

forming a key points image for frontal image based on the key points image for the side image; and

forming a frontal face image based on the key points image for frontal image.

2. The face frontalization method according to Claim 1, wherein said forming a key points image for frontal image based on the key points image for the side image comprising:

migrating locations of key points in the key points image for side image to obtain key points of frontal face image; and

obtaining a key points image for the frontal face image based on the key points of frontal face image.

3. The face frontalization method according to Claim 2, wherein the location migration of key points involves multiple location migrations of key points and said forming a key points image for frontal image based on the key points image for side image comprises:

migrating locations of key points in the key points image for side image to obtain key points in face image in the intermediate pose, with the face angle corresponding to the intermediate pose being between the side face image and the frontal face image;

migrating locations of key points in the key points image for the face image in the intermediate pose to obtain key points in frontal face image, and forming a key points image for the frontal image.

4. The face frontalization method according to Claim 2 or Claim 3, wherein the location migration of key points in key points image comprises:

determining the vicinity of the key points according to preset rules;

migrating locations of key points and their vicinity.

5. The face frontalization method according to Claim 4, wherein the location migration of key points in key points image comprises:

migrating locations of key points by means of pose transfer networks.

6. The face frontalization method according to any one of Claims 1-5, further comprising:

performing face recognition according to the frontal face image formed.

7. A face frontalization device, comprising:

a detection module designed to detect pictures to be recognized and obtain face images from the pictures to be recognized;

a side face recognition module designed to determine whether the face image obtained is a frontal or side image;

a key point detection module designed to detect key points in the side image recognized by the side face recognition module;

a key point location migration module designed to migrate locations of key points detected in the side image to obtain key points of frontal image; and

a frontal face image generation module designed to form a key points image for frontal image based on the key points in frontal image and form a frontal image based on the key points image for frontal image.

8. The face frontalization device according to Claim 7, wherein the key point location migration module is a pose transfer network.

9. The face frontalization device according to Claim 8, wherein the pose transfer network is a progressive pose attention transfer network, and the progressive pose attention transfer network consists of multiple cascaded pose attention transfer sub-networks.

10. The face frontalization device according to Claim 9, wherein the multiple cascaded pose attention transfer sub-networks comprise a first pose attention transfer sub-

network and a second pose attention transfer sub-network, of which:

the first pose attention transfer sub-network is used to migrate locations of key points in the key points image for side image to obtain key points of face image in the intermediate pose, with the face angle corresponding to the intermediate pose being between the side face image and the frontal face image;

the second pose attention transfer sub-network is used to migrate locations of key points in the key points image for face image in the intermediate pose to obtain a key points image for frontal image.

11. The face frontalization device according to Claim 7, further comprising a first determination module designed to determine the vicinity of the key points according to preset rules;

and wherein the key point location migration module is used to migrate locations of key points and their vicinity.

12. The face frontalization device according to any one of Claims 7-11, further comprising a face recognition module designed to perform face recognition on the frontal face image generated by the frontal face image generation module.

13. A computer device which comprises of: at least a processor, a memory, a communication interface and a communication bus, which processor, memory and communication interface maintain communication with each other through the communication bus; and also comprises of a memory coupled to the at least one processor, which memory stores executable instructions that make it possible to realize the method mentioned in any one of Claims 1-6 above when executed by the at least a processor.

14. A chip which comprises of: a processor, which is used to call and run any computer program from the memory and therefore makes it possible for any device installed with the chip to perform the method mentioned in any one of Claims 1-6 above.

15. A computer-readable storage medium which is characterized in storing computer programs that make it possible to implement the steps involved in the method mentioned in any one of Claims 1-6 above when executed by processor.