

CAMERA MODULE FOR PALM RECOGNITION DEVICE AND PALM RECOGNITION DEVICE

RELATED APPLICATION

[0001] The present application claims priority to Chinese Patent Application No. 202420092238.0, filed on January 12, 2024, entitled "CAMERA MODULE FOR PALM-SCAN RECOGNITION DEVICE", which is incorporated herein by reference in its entirety.

FIELD OF THE TECHNOLOGY

[0002] The present disclosure relates to the field of optical technologies, and in particular, to a camera module for a palm-scan recognition device and a palm-scan recognition device.

BACKGROUND OF THE DISCLOSURE

[0003] A palm-scan recognition device can obtain a palm image of a user, and then identify a user by recognizing a palm feature.

[0004] In a related technology, when using a palm-scan recognition device, the user needs to place a hand above a camera module (i.e., assembly) of the palm-scan recognition device, and a palm needs to be away from the camera module by 5 cm to 15 cm in general, so that the palm-scan recognition device can obtain a clear palm image. If the palm is relatively close to the camera module, the palm-scan recognition device may hardly obtain a complete palm image, causing the palm-scan recognition device to hardly identify the user.

SUMMARY

[0005] According to a first aspect, the present disclosure provides a camera module for a palm-scan recognition device. The camera module for a palm-scan recognition device includes a lens module and an image sensor;

[0006] the lens module includes a lens barrel, a first lens assembly, and a second lens assembly, the first lens assembly includes a plastic lens and/or a spherical glass lens, and the second lens assembly includes a freeform lens and/or a molded glass lens; and

[0007] the first lens assembly, the second lens assembly, and the image sensor are fixed inside the lens barrel, and the image sensor is located on an image side of the first lens assembly and the second lens assembly.

[0008] According to a second aspect, the present disclosure provides a palm-scan recognition device. The palm-scan recognition device includes the camera module for a palm-scan recognition device according to the first aspect.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic structural diagram of a camera module for a palm-scan recognition device according to an embodiment of the present disclosure.

[0010] FIG. 2 is a schematic structural diagram of a camera module for a palm-scan recognition device according to an embodiment of the present disclosure.

[0011] FIG. 3 is a schematic structural diagram of a camera module for a palm-scan recognition device according to an embodiment of the present disclosure.

[0012] FIG. 4 is a schematic structural diagram of a lens module according to an embodiment of the present disclosure.

[0013] FIG. 5 is a schematic structural diagram of a lens module according to an embodiment of the present disclosure.

[0014] FIG. 6 is a schematic structural diagram of a lens module according to an embodiment of the present disclosure.

[0015] FIG. 7 is a schematic structural diagram of a lens module according to an embodiment of the present disclosure.

[0016] FIG. 8 is a schematic structural diagram of a camera module for a palm-scan recognition device according to an embodiment of the present disclosure.

[0017] FIG. 9 is a schematic diagram of arrangement of two lens modules according to an embodiment of the present disclosure.

[0018] FIG. 10 is a schematic diagram of arrangement of two lens modules according to an embodiment of the present disclosure.

[0019] FIG. 11 is a schematic diagram of arrangement of two lens modules according to an embodiment of the present disclosure.

[0020] FIG. 12 is a schematic diagram of arrangement of two lens modules according to an embodiment of the present disclosure.

[0021] FIG. 13 is a schematic structural diagram of a lens module according to an embodiment of the present disclosure.

[0022] Illustration of the drawings is provided below.

[0023] 1. Lens module, 11. lens barrel, 12. first lens assembly, 121. plastic lens, 122. spherical glass lens, 13. second lens assembly, 131. freeform lens, 132. molded glass lens, 14. infrared filter film, 15, antireflection film, 1a. visible-light lens module, and 1b. infrared-light lens module; and

[0024] 2. image sensor.

DESCRIPTION OF EMBODIMENTS

[0025] To make objectives, technical solutions, and advantages of the present disclosure clearer, implementations provided in the present disclosure are further described below with reference to the accompanying drawings.

[0026] Terms used in the implementations of the present disclosure are merely used to explain embodiments of the present disclosure, but are not intended to limit the present disclosure. Unless otherwise defined, technical terms or scientific terms used herein are to have general meanings understood by a person skilled in the art to which the present disclosure belongs. Terms "first", "second", "third", and the like used in the patent application specification and claims of the present disclosure do not indicate any sequence, quantity, or importance, but are only used to distinguish different components. Similarly, terms "one", "a/an", or the like also do not indicate a quantity limitation, but indicate that at least one exists. Terms "include", "comprise", or the like mean that elements or objects before "include" or "comprise" include elements or objects listed after "include" or "comprise" and equivalent of the elements or objects listed after "include" or "comprise", and do not exclude another element or object. Terms "connection", "connected" or the like are not limited to a physical or mechanical connection, but may include an electrical connection, regardless of a direct connection or an indirect connection. "Up", "down", "left", "right", and the like are merely used to indicate a relative position relationship. After an absolute position of a described object changes, the relative position relationship may also correspondingly change.

[0027] Contactless palm-scan recognition and payment is proved to be a popular manner among users, which is more convenient than conventional card swiping and QR code scanning, and more secure than another biometric manner, for example, face scanning. According to statistics on a large quantity of users, when a user uses a palm-scan recognition device, a distance between a palm and a lens module (or referred to as a camera module) of the palm-scan recognition device ranges from 3 cm to 5 cm in general.

[0028] However, in a related technology, a field of view (FOV) of the camera module for a palm-scan recognition device is small. When the user uses the palm-scan recognition device, the palm needs to be away from the lens module by 5 cm to 15 cm. If the palm is 3 cm away from the lens module, the palm-scan recognition device cannot obtain a complete palm image.

[0029] In the related technology, lens modules of some palm-scan recognition device are arranged in a sunken manner, to increase the distance between the palm and the lens module. However, this results in a larger overall size of the palm-scan recognition device and easier dust accumulation on an outside of the lens module. A groove formed after the lens module is sunken is more likely to accumulate dust. Therefore, on a premise that a position of the lens module is not changed, to enable the camera module to photograph the palm at a short distance, a wide-angle lens module is to be used, that is, a field of view of the lens module is to be enlarged. However, a conventional wide-angle lens has large distortion and low clarity, and cannot meet a photographing requirement of palm recognition.

[0030] In view of the foregoing technical problem, an embodiment of the present disclosure provides a camera module for a palm-scan recognition device. As shown in FIG. 1 to FIG. 3, the camera module for a palm-scan recognition device includes a lens module 1 and an image sensor 2. The lens module 1 includes a lens barrel 11, a first lens assembly 12, and a second lens assembly 13. The first lens assembly 12 includes a plastic lens 121 and/or a spherical glass lens 122, and the second lens assembly 13 includes a freeform lens 131 and/or a molded glass lens 132. The first lens assembly 12, the second lens assembly 13, and the image sensor 2 are fixed inside the lens barrel 11, and the image sensor 2 is located on an image side of the first lens assembly 12 and the second lens assembly 13.

[0031] The first lens assembly 12 may include only the plastic lens 121, only the spherical glass lens 122, or both the plastic lens 121 and the spherical glass lens 122 (as shown in FIG. 4). Quantities and arrangements of the plastic lens 121 and the spherical glass lens 122 are not specifically limited in this embodiment of the present disclosure.

[0032] The second lens assembly 13 may include only a freeform lens 131 (as shown in FIG. 1), only a molded glass lens 132 (as shown in FIG. 2), or both the freeform lens 131 and the molded glass lens 132 (as shown in FIG. 3).

[0033] A plastic lens may also be referred to as a P (Plastic) lens, a spherical glass lens may also be referred to as a G (Glass) lens, a molded glass lens may also be referred to as a GM (Glass Molding) lens, and a freeform lens may also be referred to as a FreeForm lens.

[0034] The freeform lens 131 can enlarge a field of view of the lens module 1 and reduce distortion of the lens module 1, and can further improve relative illumination (RI) and a modulation transfer function (MTF) of the lens module 1, facilitating improvement on image quality.

[0035] The molded glass lens 132 has advantages such as high thermal stability, a high refractive index, low chromatic dispersion, a high transmittance, distortion elimination, and an expanded field of view, so that when the field of view of the lens module 1 is enlarged, the distortion of the lens module 1 can also be reduced. The molded glass lens 132 further helps the camera module for a palm-scan recognition device to be used in more demanding conditions. In addition, a conventional glass lens manufacturing technology requires complex operations, such as rough grinding, fine grinding, and polishing, taking a relatively long time. Production of the molded glass lens 132 only requires a pre-formed glass body, which can be directly molded into a finished product. Therefore, the molded glass lens 132 is quite suitable for mass production. Therefore, using the molded glass lens 132 in the camera module for a palm-scan recognition device can improve production efficiency and facilitate mass production of the camera module for a palm-scan recognition device.

[0036] The lens module 1 and the image sensor 2 in this embodiment of the present disclosure may also be used in a face-scan module.

[0037] According to the technical solution provided in this embodiment of the present disclosure, the lens module 1 in the camera module for a palm-scan recognition device includes the first lens assembly 12 and the second lens assembly 13. The second lens assembly 13 is the freeform lens 131 or the molded glass lens 132, or the second lens assembly 13 includes the freeform lens 131 and the molded glass lens 132. Both the freeform lens 131 and the molded glass lens 132 can enlarge the field of view of the lens module 1. Therefore, when the lens module 1 is configured to photograph the palm, though the palm is relatively close to the lens module 1 or the palm is slightly offset, the lens module 1 can obtain the complete palm image. In addition, both the freeform lens 131 and the molded glass lens 132 can reduce the distortion of the lens module 1, so that the distortion of the lens module 1 is relatively small and clarity of the lens module 1 is improved, thereby avoiding distortion of an image obtained by the lens module 1, to facilitate acquisition of a clear palm image. In this way, when the palm is relatively close to the lens module 1, the camera module for a palm-scan recognition device (that is, the image sensor 2) can obtain a complete and clear image, which is conducive to the camera module for a palm-scan recognition device quickly and accurately identifying a user.

[0038] According to measurement, when the second lens assembly 13 includes the freeform lens 131 and the molded glass lens 132, a horizontal field of view of the lens module may reach 125° to 135°, and a vertical field of view of the lens module 1 may reach 115° to 125°.

[0039] In some examples, a degree of freedom of the freeform lens 131 ranges from 30 to 80. In the related technology, a maximum of a degree of freedom of the freeform lens is 40. The degree of freedom of the freeform lens 131 provided in this embodiment of the present disclosure is relatively high, significantly reducing the distortion of the lens module 1. In some examples, the degree of freedom of the freeform lens 131 is greater than 40. The degree of freedom of the freeform lens 131 refers to a quantity of adjustable variables or parameters in a curved surface equation configured to describe a curved surface shape of the freeform lens 131.

[0040] Through an experiment, a distortion rate of the lens module 1 in a horizontal direction is -13.3%, and a distortion rate of the lens module 1 in a vertical direction is -6.6%. Compared with a distortion rate of -35% in the horizontal direction and a distortion rate of -22% in the vertical direction of a lens module of a conventional palm-scan recognition device, the distortion rate of the lens module 1 in this embodiment of the present disclosure is greatly reduced. In this way, a palm image obtained by the lens module 1 is clearer.

[0041] In some examples, as shown in FIG. 1 and FIG. 3, the freeform lens 131 is located on an image side of the first lens assembly 12. When the lens module 1 is assembled, lenses are placed from an object side of the lens module 1, and are gradually arranged toward an image side. The freeform lens 131 is placed on the image side of the first lens assembly 12, so that the freeform lens 131 can be mounted last. In this way, a collision between the freeform lens 131 and another lens can be avoided when the freeform lens 131 is mounted. In addition, the first lens assembly 12 can converge light. The freeform lens 131 is placed on the image side of the first lens assembly 12, so that as much light as possible converges on the freeform lens 131, which is conducive to the freeform lens 131 adjusting the light. The freeform lens 131 is a lens close to the image sensor 2 among a plurality of lenses of the second lens assembly 13. Because structural strength of the freeform lens 131 is poor, setting the freeform lens 131 as a lens closest to the image sensor 2 can protect the freeform lens 131. When the camera module for a palm-scan recognition device is bumped, the freeform lens 131 is not easily damaged.

[0042] Certainly, in some other examples, the freeform lens 131 may alternatively be located on an object side of the first lens assembly 12. Alternatively, when the first lens assembly 12 includes a plurality of lenses, the freeform lens 131 may be located inside the first lens assembly 12,

that is, located between the plurality of lenses of the first lens assembly 12. This is not specifically limited in this embodiment of the present disclosure.

[0043] In some examples, as shown in FIG. 5 and FIG. 6, a quantity of the freeform lenses 131 may be one or more. The quantity of the freeform lenses 131 is not limited in this embodiment of the present disclosure. A plurality of freeform lenses 131 may be arranged sequentially and adjacently, or may be arranged alternately with the plurality of lenses of the first lens assembly 12.

[0044] In some examples, the molded glass lens 132 is an aspherical lens, and a degree of freedom of the molded glass lens 132 ranges from 10 to 30. The molded glass lens 132 can enlarge the field of view of the lens module 1 and reduce the distortion of the lens module 1. In the related technology, the degree of freedom of the molded glass lens 132 in the lens module is 16 generally. The degree of freedom of the molded glass lens 132 provided in this embodiment of the present disclosure is relatively high, which is conducive to further enlarging the field of view of the lens module 1 and reducing the distortion of the lens module 1. In some examples, the degree of freedom of the molded glass lens 132 is greater than 16. The degree of freedom of the molded glass lens 132 refers to a quantity of adjustable variables or parameters in a curved surface equation configured to describe a curved surface shape of the molded glass lens 132.

[0045] Ordinary spherical glass may cause defocusing due to chromatic aberration, while an aspherical lens compensates for this deficiency by correcting the chromatic aberration of a sphere. In addition, optical imaging requires two, three, or more spherical lenses to perform an imaging function, which can be achieved by using an aspherical lens instead. In this way, a quantity of lenses in the lens module 1 can be reduced.

[0046] In some examples, the molded glass lens 132 is located between the plurality of lenses included in the first lens assembly 12. This facilitates support for the lens barrel 11 provided by the molded glass lens 132.

[0047] In some examples, as shown in FIG. 3, the first lens assembly 12 includes three plastic lenses 121. The second lens assembly 13 includes the molded glass lens 132. Two plastic lenses 121 are provided on an object side of the molded glass lens 132, and one plastic lens 121 is provided on an image side of the molded glass lens 132. The two plastic lenses 121, the molded glass lens 132, the plastic lens 121, and the freeform lens 131 are sequentially arranged. Placing the molded glass lens 132 at a middle position of the plurality of lenses can provide good support for the lens barrel 11.

[0048] In some other examples, as shown in FIG. 4, the first lens assembly 12 may alternatively include two plastic lenses 121 and one spherical glass lens 122. Two plastic lenses 121 are provided on the object side of the molded glass lens 132, and one spherical glass lens 122 is provided on the image side of the molded glass lens 132. The two plastic lens 121, the molded glass lens 132, the spherical glass lens 122, the freeform lens 131, and the image sensor 2 are sequentially arranged in an axial direction of the lens barrel 11. A quantity and a type of the lenses of the first lens assembly 12 and relative positions of the first lens assembly 12 and the molded glass lens 132 are not specifically limited in this embodiment of the present disclosure.

[0049] In some examples, as shown in FIG. 3, the second lens assembly 13 includes the freeform lens 131 and the molded glass lens 132, and the freeform lens 131 is located on the image side of the molded glass lens 132.

[0050] In some other examples, as shown in FIG. 6 and FIG. 7, the freeform lens 131 may be located on the object side of a molded glass lens 132.

[0051] As shown in FIG. 2 to FIG. 7, quantities and arrangements of the plastic lens 121, the spherical glass lens 122, the freeform lens 131, and the molded glass lens 132 are not specifically limited in this embodiment of the present disclosure. The plastic lens 121, the spherical glass lens 122, the freeform lens 131, and/or the molded glass lens 132 may be arranged in a free combination manner.

[0052] Because the field of view of the lens module 1 provided in this embodiment of the present disclosure is large, more light sources enter the lens module 1, so that the lens module 1 is more likely to generate glare. In other words, a light spot is likely to be generated on the palm image obtained by the lens module 1, and the light spot obscures some palm features, causing the palm-scan recognition device to hardly identify the user. To reduce the glare of the lens module 1, in some examples, an inner wall of the lens barrel 11 has an anti-glare coating, for example, ink. In this way, the anti-glare coating can absorb a part of light, preventing the palm image from being obscured by the light spot, which is conducive to the palm-scan recognition device identifying the user.

[0053] In some examples, the lens module 1 is an infrared-light lens module 1b. As shown in FIG. 8, the lens module 1 further includes an infrared filter 14, the infrared filter 14 is located on an object side of the image sensor 2, and the infrared filter 14 is configured to transmit infrared light and filter visible light.

[0054] Correspondingly, the image sensor 2 is an infrared image sensor. In this way, when a surrounding environment is relatively dark, the lens module 1 can photograph an infrared image of the palm, which is conducive to the palm-scan recognition device obtaining a palm feature in the relatively dark environment.

[0055] In some examples, when the lens module 1 is a visible-light lens module 1a, the lens module 1 may alternatively have a filter configured to filter the infrared light and transmit the visible light.

[0056] In some examples, as shown in FIG. 9, the camera module for a palm-scan recognition device includes two lens modules 1. One lens module 1 is the visible-light lens module 1a, configured to transmit the visible light, and another lens module 1 is the infrared-light lens module 1b, configured to transmit the infrared light. Correspondingly, the camera module for a palm-scan recognition device includes two image sensors 2. One image sensor 2 is a color image sensor, opposite to the visible-light lens module 1a, and is configured to receive the visible light transmitted by the visible-light lens module 1a, to form a color image. Another image sensor 2 is the infrared image sensor, opposite to the infrared-light lens module 1b, and is configured to receive the infrared light transmitted by the infrared-light lens module 1b, to form a black-and-white image. When the two lens modules 1 are used simultaneously, more palm features can be photographed, which is conducive to the palm-scan recognition device quickly recognizing the user identity.

[0057] Types, quantities, and arrangements of lenses of the visible-light lens module 1a and the infrared-light lens module 1b may be the same or different.

[0058] In some examples, as shown in FIG. 9 to FIG. 12, two lens modules 1 are arranged in a first direction shown in the accompanying drawings. An aspect ratio of an overlapping area of fields of view of the infrared-light lens module 1b and the visible-light lens module 1a is an aspect ratio of a finally obtained palm image. The two lens modules 1 are arranged in the above manner, so that the aspect ratio of the palm image can be 4:3. In this way, an image obtained by the camera module for a palm-scan recognition device can be closer to a proportion of the palm. When the palm is close, obtaining the complete palm image is easier.

[0059] For the palm-scan recognition device lens module including the visible-light lens module 1a and the infrared-light camera module 1b, a field of view area of the camera module for a palm-scan recognition device is the overlapping area of field of view areas of the visible-light lens module 1a and the infrared-light lens module 1b. For example, as shown in FIG. 11 and FIG. 12, the field of view area of the visible-light lens module 1a is a rectangular area ABCD, and the field of view area of the infrared-light lens module 1b is a rectangular area MNPQ. Therefore, the field of

view area of the camera module for a palm-scan recognition device is an overlapping area of the rectangular area ABCD and the rectangular area MNPQ, that is, a rectangular area MNCD.

[0060] Through an experiment, when an aspect ratio (or referred to as a length-to-width ratio) of the rectangular area MNCD is 4:3, image quality obtained by the camera module for a palm-scan recognition device is higher. Therefore, the aspect ratio of the rectangular area MNCD may be set to 4:3. However, an aspect ratio of the field of view area of the visible-light lens module 1a to the field of view area of the infrared-light lens module 1b provided in this embodiment of the present disclosure is generally X:3, that is, $BC:AB = X:3$, and $NP:MN = X:3$, where X is greater than 4, for example, 5. Therefore, if an overlapping area with the aspect ratio being 4:3 is to be obtained, the rectangular area ABCD and the rectangular area MNPQ need to be arranged in a length direction of the rectangular area ABCD (or the rectangular area MNPQ), where the length direction is the first direction. In this way, compared with the rectangular area ABCD (or the rectangular area MNPQ), a length of the overlapping rectangular area MNCD is reduced and a width of the overlapping rectangular area MNCD remains unchanged, so that the aspect ratio of the rectangular area MNCD can reach 4:3.

[0061] Certainly, in some other examples, the two lens modules 1 may alternatively be arranged in an other manner according to a practical requirement. This is not specifically limited in this embodiment of the present disclosure.

[0062] In some examples, as shown in FIG. 13, surfaces of the first lens assembly 12 and the second lens assembly 13 have antireflection films 15. The antireflection film 15 is configured to increase refractiveness of the lens module 1 and reduce reflection, and suppress the glare of the lens module 1 to increase a transmittance rate. In this way, the camera module for a palm-scan recognition device is more likely to obtain a clearer image. Each lens of the first lens assembly 12 and each lens of the second lens assembly 13 are plated with the antireflective film 15. A material of the antireflection film 15 may be magnesium fluoride, titanium oxide, lead sulfide, lead selenide, or the like. A thickness of the antireflection film 15 may range from 300 nm to 500 nm. A curvature of the antireflection film 15 is the same as a curvature of a lens to which the antireflection film 15 is bonded.

[0063] An embodiment of the present disclosure further provides a palm-scan recognition device. The palm-scan recognition device includes the foregoing camera module for a palm-scan recognition device.

[0064] The foregoing descriptions are merely exemplary embodiments of the present disclosure and are not intended to limit the present disclosure. Any modification, equivalent replacement, or improvement made is to fall within the protection scope of the present disclosure.

CLAIMS

What is claimed is:

1. A camera module for a palm-scan recognition device, comprising: a lens module (1) and an image sensor (2);

wherein the lens module (1) comprises a lens barrel (11), a first lens assembly (12), and a second lens assembly (13), the first lens assembly (12) comprising a plastic lens (121) and/or a spherical glass lens (122), and the second lens assembly (13) comprising a freeform lens (131) and/or a molded glass lens (132); and

the first lens assembly (12), the second lens assembly (13), and the image sensor (2) being fixed inside the lens barrel (11), and the image sensor (2) being located on an image side of the first lens assembly (12) and the second lens assembly (13).

2. The camera module for the palm-scan recognition device according to claim 1, wherein the freeform lens (131) is located on the image side of the first lens assembly (12), and the freeform lens (131) is a lens close to the image sensor (2) in a plurality of lenses of the second lens assembly (13).

3. The camera module for the palm-scan recognition device according to claim 1 or 2, wherein the molded glass lens (132) is located between a plurality of lenses comprised in the first lens assembly (12).

4. The camera module for the palm-scan recognition device according to claim 3, wherein the first lens assembly (12) comprises three plastic lenses (121); and

wherein the second lens assembly (13) comprises the molded glass lens (132), two of the plastic lenses (121) are provided on an object side of the molded glass lens (132), and one of the plastic lenses (121) is provided on an image side of the molded glass lens (132).

5. The camera module for the palm-scan recognition device according to claim 1 or 2, wherein the first lens assembly (12) comprises two plastic lenses (121) and one spherical glass lens (122),

the two plastic lens (121), the molded glass lens (132), the spherical glass lens (122), the freeform lens (131), and the image sensor (2) being sequentially arranged in an axial direction of the lens barrel (11).

6. The camera module for the palm-scan recognition device according to claim 1 or 2, wherein a degree of freedom of the freeform lens (131) ranges from 30 to 80.

7. The camera module for the palm-scan recognition device according to claim 1 or 2, wherein

a degree of freedom of the molded glass lens (132) ranges from 10 to 30.

8. The camera module for the palm-scan recognition device according to claim 1 or 2, wherein an inner wall of the lens barrel (11) has an anti-glare coating.

9. The camera module for the palm-scan recognition device according to claim 1 or 2, wherein the camera module comprises two lens modules (1) and two image sensors (2),

one of the two lens modules (1) being a visible-light lens module and being opposite to one of the two image sensors (2); and

the other of the two lens modules (1) being an infrared-light lens module and being opposite to the other of the two image sensors (2), the infrared-light lens module further comprising an infrared filter (14), the infrared filter (14) being located on an object side of the other image sensor (2), and the infrared filter (14) being configured to transmit infrared light and filter visible light.

10. A palm-scan recognition device, comprising the camera module for the palm-scan recognition device according to any one of claims 1 to 9.