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Zoom lens, camera module, and electronic device

Abstract

A zoom lens, a camera module, and an electronic device are provided. A first control end and a second control end of the zoom lens respectively control a second lens assembly and a third lens assembly to move for zooming; a third control end and a fourth control end control, under a first target focal length, the third lens assembly to move for focusing, and control, under a second target focal length, the third lens assembly to move for focusing, and the first target focal length is different from the second target focal length.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) The present application is a continuation of International Application No. PCT/CN2020/141298, filed on Dec. 30, 2020, which claims priority to Chinese Patent Application No. 201911417951.8, filed Dec. 31, 2019, the entire disclosures of which are incorporated herein by reference.

TECHNICAL FIELD
(1) The present disclosure relates to a field of consumer electronics technologies, and more particularly to a zoom lens, a camera module and an electronic device.
BACKGROUND
(2) In a related art, a zoom lens can change an overall focal length through a movement of a lens group. However, most of current driving chips are only suitable for focusing and optical image stabilization (also referred to as optical anti-shake) of a fixed focus lens. Due to a small moving distance range of the lens group during the focusing, an overall moving distance range of the zoom lens is also small when the optical image stabilization is realized, and even if a number of effective control bits of the driving chip is small, it can control the lens group to move with high precision.
SUMMARY
(3) The present disclosure provides a zoom lens, a camera module and an electronic device.
(4) A zoom lens of an embodiment of the present disclosure includes: a housing, a first lens assembly, a second lens assembly, a third lens assembly, and a first driving chip. The first lens assembly, the second lens assembly and the third lens assembly are arranged in the housing. The first lens assembly, the second lens assembly and the third lens assembly are arranged in sequential order along an optical axis of the first lens assembly. The first driving chip includes: a first control end, a second control end, a third control end and a fourth control end, the first control end is configured (i.e., structured and arranged) to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens. The third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length.
(5) A camera module of an embodiment of the present disclosure includes a photosensitive element, and a zoom lens. The photosensitive element is arranged on an image side of the zoom lens. The zoom lens includes: a housing, a first lens assembly, a second lens assembly, a third lens assembly, and a first driving chip. The first lens assembly, the second lens assembly and the third lens assembly are arranged in the housing. The first lens assembly, the second lens assembly and the third lens assembly are arranged in sequential order along an optical axis of the first lens assembly. The first driving chip includes: a first control end, a second control end, a third control end and a fourth control end, the first control end is configured to control the second lens assembly to move

relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens. The third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length.
(6) An electronic device of the present disclosure includes: a casing and the camera module of the above embodiment. The camera module is installed on the casing. The camera module includes a photosensitive element, and a zoom lens. The photosensitive element is arranged on an image side of the zoom lens. The zoom lens includes: a housing, a first lens assembly, a second lens assembly, a third lens assembly, and a first driving chip. The first lens assembly, the second lens assembly and the third lens assembly are arranged in the housing. The first lens assembly, the second lens assembly and the third lens assembly are arranged in sequential order along an optical axis of the first lens assembly. The first driving chip includes: a first control end, a second control end, a third control end and a fourth control end, the first control end is configured to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens. The third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length.
(7) Additional aspects and advantages of embodiments of the present disclosure will be given in part in the following description, and some will become apparent from the following description, or learned through the practice of the embodiments of the present disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The foregoing and/or additional aspects and advantages of the embodiments of the present application will become apparent and readily understood from the description of the embodiments in connection with the accompanying drawings below, wherein:
(2) FIG. **1** illustrates a schematic plane view of an electronic device applicable to some embodiments of the present disclosure.
(3) FIG. **2** illustrates a schematic plane view of an electronic device in another perspective applicable to some embodiments of the present disclosure.
(4) FIG. **3** illustrates a schematic three dimensional (3D) assembly view of a zoom lens applicable to some embodiments of the present disclosure.
(5) FIG. **4** illustrates a schematic 3D exploded view of a zoom lens applicable to some embodiments of the present disclosure.
(6) FIG. **5** illustrates a schematic plane view of a first driving chip applicable to some embodiments of the present disclosure.
(7) FIG. **6** illustrates a schematic plane view of a second driving chip applicable to some embodiments of the present disclosure.
(8) FIG. **7***a* and FIG. **7***b* illustrate schematic cross-sectional views of the zoom lens in FIG. **3** along a VI-VI line under different focus length states.

(9) FIG. **8** illustrates a schematic plan view of a lens of a zoom lens applicable to some embodiments.
(10) FIG. **9***a* and FIG. **9***b* illustrate schematic views of positions of a second lens assembly and a third lens assembly in different focal length states applicable to some embodiments.
(11) FIG. **10** illustrates a schematic view of a relationship between a moving distance and a current of the second lens assembly and the third lens assembly of the zoom lens applicable to some embodiments.
(12) FIG. **11** illustrates a schematic cross-sectional view of a zoom lens cut by a section line corresponding to the line VI-VI in FIG. **3** applicable to some embodiments.
(13) FIG. **12** illustrates a schematic cross-sectional view of the zoom lens along an XI-XI line in FIG. **3**.

DETAILED DESCRIPTION OF EMBODIMENTS

(14) The embodiments of the present disclosure are further described below in connection with the accompanying drawings. The same or similar numbers in the accompanying drawings indicate from beginning to end the same or similar components or components having the same or similar functions. Furthermore, the embodiments of the present disclosure described below in connection with the accompanying drawings are exemplary and are intended only to explain the embodiments of the present disclosure and are not to be construed as limiting the present disclosure.
(15) The embodiments of the present disclosure are further described below in connection with the accompanying drawings. The same or similar numbers in the accompanying drawings indicate from beginning to end the same or similar components or components having the same or similar functions.
(16) Furthermore, the embodiments of the present disclosure described below in connection with the accompanying drawings are exemplary and are intended only to explain the embodiments of the present disclosure and are not to be construed as limiting the present disclosure.
(17) In the present disclosure, unless otherwise expressly specified and limited, a first feature is “above” or “below” a second feature may be direct contact between the first and second features, or indirect contact between the first and second features through an intermediate medium. Moreover, the first feature is “above”, “over” and “on” the second feature, but the first feature is directly above or diagonally above the second feature, or simply indicates that the first feature is horizontally higher above the second feature. The first feature is “under”, “below”, and “underneath” the second feature, but the first feature is directly below or diagonally below the second feature, or simply indicates that the first feature is less than the horizontal height of the second feature.
(18) A zoom lens of an embodiment of the present disclosure includes: a housing, a first lens assembly arranged in the housing, a second lens assembly arranged in the housing, a third lens assembly arranged in the housing, and a first driving chip. The first lens assembly, the second lens assembly and the third lens assembly are arranged in sequential order along an optical axis of the first lens assembly. The first driving chip includes: a first control end, a second control end, a third control end and a fourth control end, the first control end is configured to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens, the third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length.
(19) In some embodiments, the housing includes a base plate, and the base plate includes a bearing surface; the zoom lens further includes a second driving chip and a prism assembly; the prism

assembly, the first lens assembly, the second lens assembly and the third lens assembly are arranged on the bearing surface in sequential order along the optical axis; the second driving chip is configured to control the prism assembly to move in a first direction and a second direction, thereby to realize optical image stabilization; and every two of the optical axis, the first direction and the second direction are perpendicular to each other.
(20) In some embodiments, the first direction is parallel to the bearing surface and perpendicular to the optical axis, the second direction is perpendicular to the bearing surface, and the bearing surface is parallel to the optical axis.
(21) In some embodiments, a number of effective control bits of each of the first driving chip and the second driving chip is greater than or equal to 10, and thereby a minimum moving unit of each of the second lens assembly and the third lens assembly meets a predetermined moving accuracy.
(22) In some embodiments, the zoom lens further includes a fourth lens assembly arranged in the housing, the second driving chip further includes a fifth control end, and the fifth control end is connected to the fourth lens assembly and configured to control the fourth lens assembly to move relative to the first lens assembly along the optical axis.
(23) In some embodiments, the zoom lens further includes an anti-shake driving component, the second driving chip includes a first anti-shake control end and a second anti-shake control end, the first anti-shake control end and the second anti-shake control end are connected to the anti-shake driving component, the anti-shake driving component is connected to the prism assembly, the first anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the first direction, and the second anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the second direction.
(24) In some embodiments, the prism assembly includes a prism, the prism includes an incident surface, a reflecting surface and an emitting surface connected in sequence, the first lens assembly is opposite to one of the incident surface and the emitting surface, and the reflecting surface is configured to reflect light incident into the incident surface to make the light exit from the emitting surface.
(25) In some embodiments, the zoom lens further includes a first driving component and a second driving component, the first control end is connected to the second lens assembly through the first driving component, the first control end is configured to control the first driving component to move and thereby to drive the second lens assembly to move relative to the first lens assembly along the optical axis; the second control end, the third control end and the fourth control end are connected to the second driving component, the second driving component is connected to the third lens assembly, and the second control end, the third control end and the fourth control end are configured to control the second driving component to move and thereby to drive the third lens assembly to move relative to the first lens assembly along the optical axis.
(26) In some embodiments, the first driving component includes a first coil and a first magnet, the second driving component includes a second coil and a second magnet, the first magnet is connected to the second lens assembly, the second magnet is connected to the third lens assembly, the first control end is connected to the first coil, the first control end is configured to control a current inputted to the first coil and thereby to drive the first magnet to drive the second lens assembly to move relative to the first lens assembly along the optical axis, the second control end, the third control end and the fourth control end are connected to the second coil, and the second control end, the third control end and the fourth control end are configured to control a current inputted to the second coil and thereby to drive the second magnet to drive the third lens assembly to move relative to the first lens assembly along the optical axis.
(27) In some embodiments, the housing includes a base plate, a bearing surface of the base plate is provided with a slide rail, surfaces of the second lens assembly and the third lens assembly opposite to the bearing surface are provided with balls, and the balls of the second lens assembly

and the third lens assembly are slidably connected to the slide rail and thereby the second lens assembly and the third lens assembly are movable relative to the first lens assembly along the optical axis.

(28) In some embodiments, the third control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches a preset definition, under the first target focal length; the fourth control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches the preset definition, under the second target focal length; and the first target focal length is in a short focal state, and the second target focal length is in a long focal state.

(29) A camera module of an embodiment of the present disclosure includes a photosensitive element and a zoom lens; the photosensitive element is arranged on an image side of the zoom lens; the zoom lens includes: a housing; a first lens assembly arranged in the housing, a second lens assembly arranged in the housing, a third lens assembly arranged in the housing, and a first driving chip. The first lens assembly, the second lens assembly and the third lens assembly are arranged in sequential order along an optical axis of the first lens assembly; the first driving chip includes: a first control end, a second control end, a third control end and a fourth control end. The first control end is configured to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens; the third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length.

(30) In some embodiments, the housing includes a base plate, and the base plate includes a bearing surface; the zoom lens further includes a second driving chip and a prism assembly; the prism assembly, the first lens assembly, the second lens assembly and the third lens assembly are arranged on the bearing surface in sequential order along the optical axis, the second driving chip is configured to control the prism assembly to move in a first direction and a second direction, thereby to realize optical image stabilization; and every two of the optical axis, the first direction and the second direction are perpendicular to each other.

(31) In some embodiments, the first direction is parallel to the bearing surface and perpendicular to the optical axis, the second direction is perpendicular to the bearing surface, and the bearing surface is parallel to the optical axis.

(32) In some embodiments, a number of effective control bits of each of the first driving chip and the second driving chip is greater than or equal to 10, and thereby a minimum moving unit of each of the second lens assembly and the third lens assembly meets a predetermined moving accuracy.

(33) In some embodiments, the zoom lens further includes a fourth lens assembly arranged in the housing, the second driving chip further includes a fifth control end, and the fifth control end is connected to the fourth lens assembly and configured to control the fourth lens assembly to move relative to the first lens assembly along the optical axis.

(34) In some embodiments, the zoom lens includes an anti-shake driving component, the second driving chip includes a first anti-shake control end and a second anti-shake control end, the first anti-shake control end and the second anti-shake control end are connected to the anti-shake driving component, and the anti-shake driving component is connected to the prism assembly, the first anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the first direction, and the second anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the second direction.

(35) In some embodiments, the prism assembly includes a prism, the prism includes an incident surface, a reflecting surface and an emitting surface connected in sequence, the first lens assembly is opposite to one of the incident surface and the emitting surface, and the reflecting surface is configured to reflect light incident into the incident surface to make the light exit from the emitting surface.
(36) In some embodiments, the zoom lens further includes a first driving component and a second driving component, the first control end is connected to the second lens assembly through the first driving component, and the first control end is configured to control the first driving component to move and thereby to drive the second lens assembly to move relative to the first lens assembly along the optical axis; the second control end, the third control end and the fourth control end are connected to the second driving component, the second driving component is connected to the third lens assembly, and the second control end, the third control end and the fourth control end are configured to control the second driving component to move and thereby to drive the third lens assembly to move relative to the first lens assembly along the optical axis.
(37) In some embodiments, the first driving component includes a first coil and a first magnet, the second driving component includes a second coil and a second magnet, the first magnet is connected to the second lens assembly, the second magnet is connected to the third lens assembly, and the first control end is connected to the first coil, the first control end is configured to control a current inputted to the first coil and thereby to drive the first magnet to drive the second lens assembly to move relative to the first lens assembly along the optical axis, the second control end, the third control end and the fourth control end are connected to the second coil, and the second control end, the third control end and the fourth control end are configured to control a current inputted to the second coil and thereby to drive the second magnet to drive the third lens assembly to move relative to the first lens assembly along the optical axis.
(38) In some embodiments, the housing includes a base plate, a bearing surface of the base plate is provided with a slide rail, surfaces of the second lens assembly and the third lens assembly opposite to the bearing surface are provided with balls, and the balls of the second lens assembly and the third lens assembly are slidably connected to the slide rail, thereby the second lens assembly and the third lens assembly are movable relative to the first lens assembly along the optical axis.
(39) In some embodiments, the third control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches a preset definition, under the first target focal length; and the fourth control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches the preset definition, under the second target focal length; and the first target focal length is in a short focal state, and the second target focal length is in a long focal state.
(40) An electronic device of an embodiment of the present disclosure includes: a casing; and the camera module according to any one of above embodiments, and the camera module is installed on the casing.
(41) Referring to FIGS. **1** and **2**, an electronic device **1000** includes a casing **200** and a camera module **100**. The camera module **100** is combined with the casing **200**. Specifically, the electronic device **1000** may be a mobile phone, a tablet computer, a display, a notebook computer, a teller machine, a gate machine, a smart watch, a head display device, a game console, etc. The embodiments of the present disclosure takes the electronic device **1000** is the mobile phone as an example. It can be understood that the specific form of the electronic device **1000** is not limited to the mobile phone.
(42) The casing **200** can be used to install the camera module **100**, or the casing **200** can be used as an installation carrier of the camera module **100**. The electronic device **1000** includes a front **901** and a back **902**. The camera module **100** can be arranged on the front **901** as a front camera, and

the camera module **100** can also be arranged on the back **902** as a rear camera. In the embodiments of the present disclosure, the camera module **100** is arranged on the back **902** as the rear camera. The casing **200** can further be used to install the camera module **100**, a power supply device, a communication device and other functional assemblies of the electronic device **1000**, therefore the casing **200** provides dust-proof, anti-falling, waterproof and other protection for the functional assemblies.

(43) Referring to FIGS. **3** to **5**, the camera module **100** includes a zoom lens **10** and a photosensitive element **50**, the photosensitive element **50** is mounted on an image side of the zoom lens **10**. The photosensitive element **50** may adopt a complementary metal oxide semiconductor (CMOS) photosensitive element or a charge coupled device (CCD) photosensitive element.

(44) Referring to FIGS. **3** to **6**, the zoom lens **10** of the embodiment of the present disclosure includes a housing **11**, a first lens assembly **12**, a second lens assembly **13**, a third lens assembly **14** and a first driving chip **161**. The first lens assembly **12**, the second lens assembly **13** and the third lens assembly **14** are arranged in the housing **11**. The first lens assembly **12**, the second lens assembly **13** and the third lens assembly **14** are arranged in sequential order along an optical axis O of the first lens assembly **12**. The optical axis O of the first lens assembly **12**, an optical axis of the second lens assembly **13** and an optical axis of the third lens assembly **14** coincide. The first driving chip **161** includes a first control end **1611**, a second control end **1612**, a third control end **1613** and a fourth control end **1614**. The first control end **1611** is configured to control the second lens assembly **13** to move relative to the first lens assembly **12** along the optical axis O to realize zooming of the zoom lens **10** and the second control end **1612** is configured to control the third lens assembly **14** to move relative to the first lens assembly **12** along the optical axis O to realize zooming of the zoom lens **10**. The third control end **1613** is configured to control the third lens assembly **14** to move relative to the first lens assembly **12** along the optical axis O under a first target focal length to realize focusing of the zoom lens **10**. The fourth control end **1614** is configured to control the third lens assembly **14** to move along the optical axis O relative to the first lens assembly **12** under a second target focal length to realize focusing of the zoom lens **10**. The first target focal length is different from the second target focal length. The first target focal length is greater than the second target focal length, or the first target focal length is less than the second target focal length. In the embodiment of the present disclosure, the first target focal length is less than the second target focal length.

(45) In a zoom lens, a moving distance range of a lens group during zooming is large, and an accuracy requirements for focusing after the zooming is high. When there are few effective control bits of a driving chip, it is difficult to realize the zooming and ensure the moving accuracy of the zoom lens at the same time.

(46) In the zoom lens **10** according to the embodiment of the present disclosure, the first driving chip **161** controls the second lens assembly **13** and the third lens assembly **14** to move relative to the first lens assembly **12** along the optical axis O through the first control end **1611** and the second control end **1612** to realize the zooming of the zoom lens **10**. When the zoom lens **10** is in different focal length states (such as the first target focal length or the second target focal length), the third control end **1613** and the fourth control end **1614** each are configured to control the third lens assembly **14** to move to realize the focusing of the zoom lens **10**. During the focusing, the third control end **1613** and the fourth control end **1614** only need to control the third lens group **14** to move in a small moving distance range in a corresponding current focal length state, the first driving chip **161** has fewer effective control bits and can also control the lens group (such as the second lens assembly **13** and the third lens assembly **14**) to move with high precision. During the zooming, the moving distance range is relatively large, but the accuracy requirements are low. During the focusing, the moving distance range is small, but the accuracy requirements are high. Therefore, the zoom lens **10** realizes the zooming and the focusing by reasonably allocating the control ends of the driving chip, which ensures the moving accuracy of the focusing when there are

few effective control bits of the driving chip.
(47) As shown in FIG. **3**, for the convenience of subsequent description, a direction parallel to the optical axis O is defined as a X direction, and two directions perpendicular to the X direction are defined as a Y direction and a Z direction respectively, that is, every two of the X direction, the Y direction and the Z direction are perpendicular to each other.
(48) Referring to FIGS. **3**, **4**, **7***a* and **7***b*, a zoom lens **10** includes a housing **11**, a prism assembly **15**, a first lens assembly **12**, a second lens assembly **13**, a third lens assembly **14** and a driving assembly **16**. The prism assembly **15**, the first lens assembly **12**, the second lens assembly **13** and the third lens assembly **14** are arranged in the housing **11** in sequential order. Both the second lens assembly **13** and the third lens assembly **14** can move relative to the first lens assembly **12** along the optical axis O under the control of the driving assembly **16**.
(49) The housing **11** includes a base plate **111**, a side plate **112**, and a cover plate **113**. The base plate **111**, the side plate **112** and the cover plate **113** surround a receiving space **114**, and the prism assembly **15**, the first lens assembly **12**, the second lens assembly **13** and the third lens assembly **14** are arranged in the receiving space **114**.
(50) The base plate **111** includes a bearing surface **1111**. The bearing surface **1111** is parallel to the optical axis O. The bearing surface **1111** is configured to support the side plate **112**, the prism assembly **15**, the first lens assembly **12**, the second lens assembly **13** and the third lens assembly **14**. The base plate **111** may be a cuboid structure, a cube structure, a cylinder structure, or a structure of other shapes, and is not limited here. In this embodiment, the base plate **111** is the cuboid structure.
(51) A slide rail **1112** is arranged on the bearing surface **1111**. An extension direction of the slide rail **1112** is parallel to the X direction. A number of the slide rail **1112** is one or more, for example, the number of the slide rail **1112** is one, two, three, four, or even more. In this embodiment, the number of the slide rail **1112** is two (the two slide rails **1112** are represented by the first slide rail **1113** and the second slide rail **1114** respectively). The extension directions of the first slide rail **1113** and the second slide rail **1114** are parallel to the X direction, and the second slide rail **1114** and the first slide rail **1113** are arranged in sequential order along the Y direction. In the X direction, a first distance between an end of the first slide rail **1113** close to the prism assembly **15** and the prism assembly **15** and a second distance between an end of the second slide rail **1114** close to the prism assembly **15** and the prism assembly **15** may be the same or different. A third distance between another end of the first slide rail **1113** facing away from the prism assembly **15** and the prism assembly **15** and a fourth distance between another end of the second slide rail **1114** facing away from the prism assembly **15** and the prism assembly **15** may be the same or different. For example, the difference between the first distance and the second distance may be that the first distance is greater than the second distance, or the first distance is less than the second distance. The difference between the third distance and the fourth distance may be that the third distance is greater than the fourth distance, or the third distance is less than the fourth distance. In this embodiment, the first distance is greater than the second distance, and the third distance is greater than the fourth distance. In this way, the movements of the second lens assembly **13** and the third lens assembly **14** are limited by the first slide rail **1113** and the second slide rail **1114**.
(52) The side plate **112** is arranged around an edge of the base plate **111**. The side plate **112** is perpendicular to the bearing surface **1111** of the base plate **111**. The side plate **112** can be arranged on the base plate **111** by gluing, screwing, clamping, etc. The side plate **112** may also be integrally formed with the base plate **111**.
(53) The side plate **112** includes a first side plate **1121** parallel to the X direction and a second side plate **1122** parallel to the X direction, and the first side plate **1121** is opposite to the second side plate **1122**.
(54) Referring to FIG. **3** and FIG. **4**, the cover plate **113** is arranged on the side plate **112**. Specifically, the cover plate **113** can be installed on an upper surface of the side plate **112** by

clamping, screwing, gluing, etc.
(55) A surface of the cover plate **113** facing away from the side plate **112** is provided with a light inlet **1131**, and a depth direction of the light inlet **1131** can be perpendicular to the X direction, therefore the camera module **100** has a periscopic structure as a whole. In other embodiments, the light inlet **1131** is not a through hole, but a transparent solid structure from which light can enter the receiving space **114** and enter the prism assembly **15**.
(56) Referring to FIGS. **7***a* and **7***b*, the prism assembly **15** is arranged on the bearing surface **1111** of the base plate **111** and is located in the receiving space **114**. The prism assembly **15** includes a mounting table **151** and a prism **152**.
(57) The mounting table **151** is arranged on the bearing surface **1111** of the base plate **111**. Specifically, the mounting table **151** can be installed on the bearing surface **1111** by gluing, screwing, clamping, etc., and the mounting table **151** can also be integrally formed with the base plate **111**. The mounting table **151** is provided with a light inlet through hole **153**, a light outlet through hole **154** and a holding cavity **155**. The light inlet through hole **153** and the light outlet through hole **154** communicate the holding cavity **155** with the receiving space **114**. The light inlet through hole **153** is opposite to the light inlet **1131**, and the light outlet through hole **154** is opposite to the first lens assembly **12**.
(58) The prism **152** is arranged in the holding cavity **155**, and the prism **152** can be installed on the mounting table **151** by gluing, clamping, etc. The prism **152** includes an incident surface **156**, a reflecting surface **157** and an emitting surface **158**. The reflecting surface **157** obliquely connects the incident surface **156** and the emitting surface **158**. An included angle between the reflecting surface **157** and the bearing surface **1111** can be 15 degrees, 30 degrees, 45 degrees, 60 degrees, 75 degrees, etc. In this embodiment, the included angle between the reflecting surface **157** and the bearing surface **1111** may be 45 degrees. The incident surface **156** is opposite to the light inlet through hole **153**, and the emitting surface **158** is opposite to the light outlet through hole **154**. The reflecting surface **157** is configured to reflect light incident into the incident surface **156**, therefore the light exits from the emitting surface **158**. The prism **152** is configured to change an exit direction of the light entered from the light inlet through hole **153**. The prism **152** may be a triangular prism **152**. Specifically, a cross section of the prism **152** is a right triangle, two right angle edges of the right triangle are respectively formed by the incident surface **156** and the emitting surface **158**, and an inclined edge of the right triangle is formed by the reflecting surface **157**.
(59) Referring to FIGS. **4**, **7***a* and **7***b*, the first lens assembly **12** includes a first housing **121** and a first lens group **122**. The first lens group **122** is arranged in the first housing **121**.
(60) The first housing **121** is arranged in the receiving space **114**. Specifically, the first housing **121** can be installed on the bearing surface **1111** by gluing, screwing, clamping, etc., and the first housing **121** can also be integrally formed with the base plate **111**. The first housing **121** includes a light inlet hole **123**, a light outlet hole **124** and a receiving cavity **125**. The light inlet hole **123** and the light outlet hole **124** communicate the receiving cavity **125** with the receiving space **114**. The light inlet hole **123** is opposite to the light outlet through hole **154** of the prism assembly **15**, and the light outlet hole **124** is opposite to the second lens assembly **13**.
(61) The first lens group **122** is located in the receiving cavity **125**, and the first lens group **122** can be installed in the first housing **121** by gluing, screwing, clamping, etc. The first lens group **122** is opposite to the emitting surface **158** of the prism **152**. The first lens group **122** may have a positive focal power or a negative focal power. In this embodiment, the first lens group **122** has the negative focal power.
(62) The first lens group **122** includes one or more first lenses **1221**. For example, the first lens group **122** may include only one first lens **1221**, which is a convex lens or a concave lens. In at least one alternative embodiment, the first lens group **122** includes a plurality of first lenses **1221** (such as two, three, etc.), which may be convex, concave, or partially convex and partially concave.

In this embodiment, the first lens group **122** includes two first lenses **1221**. The first lens **1221** may be a glass lens or a plastic lens.
(63) The one or more first lenses **1221** each may be a part of a rotating body, or ones of the one or more first lenses **1221** each may be the rotating body and the other ones of the one or more first lenses **1221** each may be the part of the rotating body. In this embodiment, each first lens **1221** is a part of a rotating body. For example, as shown in FIG. **8**, the first lens **1221** first forms a rotating body lens S**1** through a mold. A shape of the rotating body lens S**1** cut by a plane perpendicular to the optical axis O is a circle with a diameter of R, and then an edge of the rotating body lens S**1** is cut to form the first lens **1221**. A shape of the first lens **1221** cut by the plane perpendicular to the optical axis O is a rectangle. Two edges of the rectangle are T**1** and T**2**, T**1**/R∈[0.5,1), T**2**/R∈[0.5,1). For example, T**1**/R may be 0.5, 0.6, 0.7, 0.75, 0.8, 0.95, etc., and T**2**/R may be 0.55, 0.65, 0.7, 0.75, 0.85, 0.9, etc. It can be understood that the specific ratios of T**1**/R and T**2**/R are determined according to factors such as a size of an internal space of the electronic device **1000** and optical parameters (such as a size of an effective optical area of the first lens **1221**) of the zoom lens **10**. In at least one alternative embodiment, the lenses in the first lens group **122** are made directly using a special mold, and a mold cavity of the mold is a part of a rotating body that has determined the specific ratios of T**1**/R and T**2**/R, thereby to directly make the first lens **1221**. In this way, the first lens **1221** is the part of the rotating body lens S**1**, compared with the complete rotating body lens S**1**, the volume is smaller, which reduces the overall volume of the zoom lens **10** and is conducive to the miniaturization of the electronic device **1000**.
(64) Referring to FIGS. **4**, **7***a* and **7***b*, the second lens assembly **13** includes a second housing **131**, a second lens group **132** and a first ball **133**. The second lens group **132** is mounted in the second housing **131**. When the second housing **131** slides, the second housing **131** drives the second lens group **132** to slide.
(65) The second housing **131** is provided with a first light inlet **135** and a first light outlet **136** corresponding to the second lens group **132**. The second housing **131** is formed with a first holding space **137** to hold the second lens group **132**, and the first holding space **137** is communicated with the receiving space **114** through the first light inlet **135** and the first light outlet **136**. The first light inlet **135** is opposite to the light outlet hole **124** of the first lens assembly **12**, and the first light outlet **136** is opposite to the third lens assembly **14**.
(66) The second housing **131** further includes a first top surface **138** and a first bottom surface **139** (i.e., a surface of the second housing **131** opposite the bearing surface **1111**) opposite to each other. The first top surface **138** is opposite to the cover plate **113**. The first bottom surface **139** is opposite to the bearing surface **1111** of the base plate **111**. The first bottom surface **139** is provided with a first groove **1391**, the first ball **133** is arranged in the first groove **1391** and in contact with a bottom of the slide rail **1112**, and the first ball **133** is slidably connected to the slide rail **1112**.
(67) Specifically, the first groove **1391** matches a shape of the first ball **133**. For example, the first ball **133** is spherical and has low moving resistance, the first groove **1391** is a semicircular groove, and a diameter of the first ball **133** is equal to that of the first groove **1391**, that is, a half of the first ball **133** is located in the first groove **1391**. The first ball **133** and the first groove **1391** are closely combined. When the first ball **133** moves, it can drive the second housing **131** of the second lens assembly **13** to move. The slide rail **1112** may be a groove formed on the bearing surface **1111** with an extension direction parallel to the X direction, and the slide rail **1112** may also be a bump arranged on the bearing surface **1111** with an extension direction parallel to the X direction. The surface of the bump opposite to the bottom surface of the second housing **131** forms a groove matched with the first ball **133**. In this embodiment, the slide rail **1112** is a groove formed on the bearing surface **1111** with an extension direction parallel to the X direction. After the second lens assembly **13** is installed in the receiving space **114**, a part of the first ball **133** is located in the slide rail **1112** and in contact with the bottom of the slide rail **1112**. A shape of an inner wall of the slide rail **1112** cut by the plane perpendicular to the X direction is a first arc, an outer contour of the first

ball **133** cut by the plane perpendicular to the X direction is a second arc, and a curvature of the first arc is the same as that of the second arc. Thus, in the Y direction, the outer wall of the first ball **133** is closely combined with the inner wall of the slide rail **1112**, and the opposite sides of the outer wall of the first ball **133** are in contact with the opposite sides of the inner wall of the slide rail **1112**.

(68) A number of the first groove **1391** is one or more. For example, the number of the first groove **1391** is one, two, three, four, or even more. In this embodiment, the number of the first groove **1391** is three. A number of the first ball **133** may also be one or more. In this embodiment, the number of the first ball **133** is the same as the number of the first groove **1391**, and there are also three. The three first grooves **1391** are spaced on the first bottom surface **139**.

(69) A number of the slide rail **1112** can be determined according to positions of the three first grooves **1391**. For example, a connecting line of the three first grooves **1391** is parallel to the optical axis O, only one slide rail **1112** needs to be set. For another example, the three first grooves **1391** are divided into two groups (hereinafter referred to as a first group and a second group). The first group includes one first groove **1391**, the second group includes two first grooves **1391**, and the first groove **1391** of the first group is not on the connecting line of the two first grooves **1391** of the second group (that is, the three first grooves **1391** can be surrounded into a triangle), and two slide rails **1112** are required to correspond to the first group and the second group respectively. In this embodiment, the three first grooves **1391** are divided into the first group and the second group. The first group includes the one first groove **1391**, and the second group includes the two first grooves **1391**. The first group corresponds to the first slide rail **1113**, and the second group corresponds to the second slide rail **1114**. In this way, the first ball **133** corresponding to the first group slides in the first slide rail **1113**, the first balls **133** corresponding to the second group slide in the second slide rail **1113**, the first ball **133** corresponding to the first group and the first balls **133** corresponding to the second group are limited in the first slide rail **1113** and the second slide rail **1114** respectively, and the three first balls **133** form a triangle (a center of the first ball **133** in the first slide rail **1113** is an apex of the triangle), on the premise of ensuring the sliding stability, the number of the first ball **133** can be reduced as much as possible to reduce the sliding resistance. Moreover, in the Y direction, opposite sides of an outer wall of the first ball **133** corresponding to the first group are in contact with opposite sides of an inner wall of the first slide rail **1113**, and opposite sides of an outer wall of each first ball **133** corresponding to the second group are in contact with opposite sides of an inner wall of the second slide rail **1114**, the three first balls **133** form the triangle, which can prevent the second lens assembly **13** from shaking or tilting in the Y direction, therefore, the imaging quality of the camera module **100** is not affected. In addition, since the first distance is greater than the second distance, when the second lens assembly **13** slides in the X direction (that is, when sliding to the first lens assembly **12**), the first ball **133** corresponding to the first group is in contact with an end of the first slide rail **1114** close to the prism assembly **15** to restrict the second lens assembly **13** from sliding to the first lens assembly **12** and thereby to limit the moving distance of the second lens assembly **13**.

(70) The second lens group **132** is arranged in the first holding space **137**. Specifically, the second lens group **132** can be installed in the first holding space **137** by gluing, screwing, clamping, etc. The second lens group **132** may have a positive focal power or a negative focal power. In this embodiment, the second lens group **132** has the positive focal power.

(71) The second lens group **132** includes one or more second lenses **1321**. The second lens group **132** may include only one second lens **1321**, which is a convex lens or a concave lens. In at least one alternative embodiment, the second lens group **132** includes a plurality of second lenses **1321** (such as two, three, etc.), which may be convex, concave, or partially convex and partially concave. In this embodiment, the second lens group **132** includes three second lenses **1321**. The second lens **1321** may be a glass lens or a plastic lens.

(72) Referring to FIG. **8**, the one or more second lenses **1321** each may be a part of a rotating body,

or ones of the one or more second lenses **1321** each may be the rotating body and the other ones of the one or more second lenses **1321** each may be the part of the rotating body. In this embodiment, each second lens **1321** is the part of the rotating body. For example, the second lens **1321** first forms a rotating body lens S**1** through a mold. A shape of the rotating body lens S**1** cut by a plane perpendicular to the optical axis O is a circle with a diameter of R, and then an edge of the rotating body lens S**1** is cut to form the second lens **1321**. A shape of the second lens **1321** cut by the plane perpendicular to the optical axis O is a rectangle. Two sides of the rectangle are T**1** and T**2**, T**1**/R∈[0.5,1), T**2**/R∈[0.5,1). For example, T**1**/R may be 0.5, 0.6, 0.7, 0.75, 0.8, 0.95, etc., and T**2**/R may be 0.55, 0.65, 0.7, 0.75, 0.85, 0.9, etc. It can be understood that the specific ratios of T**1**/R and T**2**/R is determined according to a size of an internal space of the electronic device **1000**, optical parameters (such as a size of an effective optical area of the second lens **1321**) of the zoom lens **10** and other factors. In at least one alternative embodiment, the second lens **1321** is made directly using a special mold, and a mold cavity of the mold is the part of the rotating body that has determined the specific ratios of T**1**/R and T**2**/R, and thereby to directly make the second lens **1321**. Thus, the second lens **1321** is the part of the rotating body lens S**1** and has a smaller volume than the complete rotating body lens S**1**, which reduces the overall volume of the zoom lens **10** and is conducive to the miniaturization of the electronic device **1000**. It should be noted that FIG. **8** is only used to illustrate the first lens **1221** and the second lens **1321**, not to represent a size of the second lens **1321**, and it should not be understood that the size of the second lens **1321** is the same as that of the first lens **1221**.

(73) Referring to FIGS. **4**, **7***a* and **7***b*, the third lens assembly **14** includes a third housing **141**, a third lens group **142** and a third ball **143**. The third lens group **142** is mounted in the third housing **141**. When the third housing **141** slides, the third housing **141** drives the third lens group **142** to slide.

(74) The third housing **141** is provided with a second light inlet **145** and a second light outlet **146** corresponding to the third lens group **142**. The third housing **141** is formed with a second holding space **147** to hold the third lens group **142**, and the second holding space **147** is communicated with the receiving space **114** through the second light inlet **145** and the second light outlet **146**. The second light inlet **145** is opposite to the first light outlet **136** of the second lens assembly **13**, and the second light outlet **146** is opposite to the photosensitive element **50** (the photosensitive element **50** is arranged on an inner surface of the side plate **112** opposite to the second light outlet **146**).

(75) The third housing **141** includes a second top surface **148** and a second bottom surface **149** (a surface of the third housing **141** opposite to the bearing surface **1111**). The second top surface **148** is opposite to the cover plate **113**. The second bottom surface **149** is opposite to the bearing surface **1111** of the base plate **111**. The second bottom surface **149** is provided with a third groove **1491**, the third ball **143** is arranged in the third groove **1491** and in contact with the bottom of the slide rail **1112**, and the third ball **143** is slidably connected to the slide rail **1112**.

(76) Specifically, the third groove **1491** matches a shape of the third ball **143**. For example, the third ball **143** is spherical and has low moving resistance, the third groove **1491** is a semicircular groove, and a diameter of the third ball **143** is equal to that of the third groove **1491**, that is, a half of the third ball **143** is located in the third groove **1491**. The third ball **143** and the third groove **1491** are closely combined. When the third ball **143** moves, it can drive the third housing **141** of the third lens assembly **14** to move. After the third lens assembly **14** is installed in the receiving space **114**, the part of the third ball **143** is located in the slide rail **1112** and in contact with the bottom of the slide rail **1112**. A shape of an inner wall of the slide rail **1112** cut by a plane perpendicular to the X direction is a first arc, an outer contour of the third ball **143** cut by the plane perpendicular to the X direction is a second arc, and a curvature of the first arc is the same as that of the second arc. Thus, in the Y direction, the outer wall of the third ball **143** is closely combined with the inner wall of the slide rail **1112**, and the opposite sides of the outer wall of the third ball **143** are in contact with the opposite sides of the inner wall of the slide rail **1112**.

(77) A number of the third groove **1491** is one or more. For example, the number of the third groove **1491** is one, two, three, four, or even more. In this embodiment, the number of the third groove **1491** is three. A number of the third ball **143** may also be one or more. In this embodiment, the number of the third ball **143** is the same as the number of the third groove **1491**, and there are also three. The three third grooves **1491** are spaced on the second bottom surface **149**.
(78) In this embodiment, the three third grooves **1491** are divided into a third group and a fourth group. The third group includes one third groove **1491**, the fourth group includes two third grooves **1491**, the third group corresponds to the first slide rail **1113**, and the fourth group corresponds to the second slide rail **1114**. In this way, the third ball **143** corresponding to the third groove **1491** of the third group slides in the first slide rail **1113**, the third balls **143** corresponding to the third grooves **1491** of the fourth group slide in the second slide rail **1113**, the third ball **143** corresponding to the third group and the third balls **143** corresponding to the fourth group are limited in the first slide rail **1113** and the second slide rail **1114** respectively, and the three third balls **143** form a triangle. On the premise of ensuring the sliding stability, reducing the number of the third ball **143** as much as possible can reduce the sliding resistance. Moreover, in the Y direction, opposite sides of an outer wall of the third ball **143** corresponding to the third group are in contact with the opposite sides of the inner wall of the first slide rail **1113**, and opposite sides of the outer wall of each third ball **143** corresponding to the fourth group are in contact with the opposite sides of the inner wall of the second slide rail **1114**, and the three third balls **143** form a triangle, which can prevent the third lens assembly **14** from shaking or tilting in the Y direction, Thus, the imaging quality of the camera module **100** is not affected. In addition, when the third lens assembly **14** slides in a opposite direction of the X direction (that is, when sliding to the photosensitive element **50**), the third ball **143** corresponding to the third group will first contact the end of the first slide rail **1113** close to the photosensitive element **50**, thereby to restrict the third lens assembly **14** from sliding in the opposite direction of the X direction. The first slide rail **1113** can limit the moving distance of the third lens assembly **14**. The third ball **143** corresponding to the third group is in contact with the end of the first slide rail **1114** facing away from the prism assembly **15** to limit the continuous sliding of the third lens assembly **14** to the photosensitive element **50**, and thereby to limit the moving distance of the third lens assembly **14**. Compared with the first distance equal to the second distance and the third distance equal to the fourth distance, when the first distance is greater than the second distance and the third distance is greater than the fourth distance, a length of the first slide rail **1113** is smaller.
(79) The third lens group **142** is arranged in the second holding space **147**. Specifically, the third lens group **142** can be installed in the second holding space **147** by gluing, screwing, clamping, etc. The third lens group **142** may have a positive or negative focal power. In this embodiment, the third lens group **142** has the negative focal power.
(80) The third lens group **142** includes one or more third lenses **1421**. The third lens group **142** includes only one third lens **1421**, which is a convex lens or a concave lens. In at least one alternative embodiment, the third lens group **142** includes a plurality of third lenses **1421** (such as two, three, etc.), which may be convex, concave, or partially convex and partially concave. In this embodiment, the third lens group **142** includes two third lenses **1421**. The third lens **1421** may be a glass lens or a plastic lens.
(81) Referring again to FIG. **8**, the one or more third lenses **1421** each may be a part of a rotating body, or ones of the one or more third lenses **1421** each may be the rotating body and the other ones of the one or more third lenses **1421** each may be the part of the rotating body. In this embodiment, each third lens **1421** is the part of the rotating body. For example, the third lens **1421** first forms a rotating body lens S**1** through a mold. A shape of the rotating body lens S**1** cut by the plane perpendicular to the optical axis O is a circle with a diameter of R, and then an edge of the rotating body lens S**1** is cut to form the third lens **1421**. A shape of the third lens **1421** cut by the plane perpendicular to the optical axis O is a rectangle. Two sides of the rectangle are T**1** and T**2**,

T**1**/R∈[0.5,1), T**2**/R∈[0.5,1). For example, T**1**/R may be 0.5, 0.6, 0.7, 0.75, 0.8, 0.95, etc., and T**2**/R may be 0.55, 0.65, 0.7, 0.75, 0.85, 0.9, etc. It can be understood that the specific ratios of T**1**/R and T**2**/R are determined according to a size of an internal space of the electronic device **1000**, optical parameters (such as a size of an effective optical area of the third lens **1421**) of the zoom lens **10** and other factors. In at least one alternative embodiment, the third lens **1421** is made directly using a special mold, and the mold cavity of the mold is a part of the rotating body that has determined the specific ratios of T**1**/R and T**2**/R, and thereby to directly make the third lens **1421**. Thus, the third lens **1421** is the part of the rotating body lens S**1** and has a smaller volume than the complete rotating body lens S**1**, which reduces the overall volume of the zoom lens **10** and is conducive to the miniaturization of the electronic device **1000**. It should be noted that FIG. **8** is only used to illustrate the first lens **1221**, the second lens **1321** and the third lens **1421**, and is not used to represent the size of the third lens **1421**, nor should it be understood that the size of the third lens **1421**, the size of the second lens **1321** and the size of the first lens **1221** are the same.
(82) Referring to FIGS. **4**, **7***a* and **7***b*, the driving assembly **16** includes a first driving component **162**, a second driving component **163**, an anti-shake driving component **164**, a first driving chip **161** and a second driving chip **166**. The first driving chip **161** is connected to the first driving component **162** and the second driving component **163**, and the second driving chip **166** is connected to the anti-shake driving component **164**.
(83) The first driving component **162** includes a first coil **1621** and a first magnet **1622**.
(84) A number of the first coil **1621** is one or more. For example, the number of the first coil **1621** is one, two, three, four, or even more. In this embodiment, the number of the first coil **1621** is one. The first coil **1621** is arranged on the first side plate **1121** or the second side plate **1122**. In this embodiment, the first coil **1621** is arranged on an inner surface of the first side plate **1121**, and the first coil **1621** can be installed on the first side plate **1121** by gluing, screwing, clamping, etc. In other embodiments, there are two first coils **1621**, and the two first coils **1621** are respectively arranged on the first side plate **1121** and the second side plate **1122**. The first coil **1621** may be arranged at any position of the first side plate **1121**. For example, the first coil **1621** may be arranged on the inner surface (i.e., the surface located in the receiving space **114**) of the first side plate **1121** and between the second lens group **132** and the third lens group **142**. In at least one alternative embodiment, the first coil **1621** may be arranged on the inner side of the first side plate **1121** and between the first lens assembly **12** and the second lens assembly **13**, and so on, which will not be repeated here. In this embodiment, the first coil **1621** may be arranged on the inner side of the first side plate **1121** and between the second lens group **132** and the third lens group **142**. In other embodiments, the first coil **1621** may be disposed on the first housing **121** and opposite to the first magnet **1622**.
(85) The first magnet **1622** is connected to the second lens group **132**. Specifically, the first magnet **1622** is arranged on the second housing **131**, and the first magnet **1622** can be arranged at any position of the second housing **131**. For example, the first magnet **1622** is arranged on the surface of the second housing **131** opposite to the third housing **141**, or the first magnet **1622** is arranged on the surface of the second housing **131** opposite to the first lens assembly **12**, etc. In this embodiment, the first magnet **1622** is arranged on the surface of the second housing **131** opposite to the third housing **141**. The first magnet **1622** may be mounted on the second housing **131** by gluing, screwing, clamping, etc. The first magnet **1622** may be a metal having magnetism. For example, the first magnet **1622** may be any one of iron, cobalt and nickel, or the first magnet **1622** may be an alloy composed of at least two of iron, cobalt and nickel.
(86) The second driving component **163** includes a second coil **1631** and a second magnet **1632**.
(87) A number of the second coil **1631** is one or more. For example, the number of the second coil **1631** is one, two, three, four, or even more. In this embodiment, the number of the second coil **1631** is one. The second coil **1631** is arranged on the first side plate **1121** or the second side plate **1122**. In this embodiment, the second coil **1631** is arranged on the first side plate **1121**, and the second

coil **1631** can be installed on the first side plate **1121** by gluing, screwing, clamping, etc. In other embodiments, the number of the second coil **1631** are two, and the two second coils **1631** are respectively arranged on the first side plate **1121** and the second side plate **1122**. The second coil **1631** may be arranged at any position of the side plate **112**. For example, the second coil **1631** may be arranged on the inner side of the first side plate **1121** and located between the second lens group **132** and the third lens group **142**. In at least one alternative embodiment, the second coil **1631** may be arranged on the inner side of the first side plate **1121** and on the side of the third lens group **142** opposite to the second lens group **132**. In at least one alternative embodiment, the second coil **1631** may be arranged on the inner surface (that is, the second coil **1631** is located on the side of the third lens group **142** opposite to the second lens group **132** and opposite to the second magnet **1632**) of the side plate **112** opposite to the third lens group **142**, and so on, which will not be repeated here. In this embodiment, the second coil **1631** is arranged on the inner side of the first side plate **1121** and is located on the side of the third lens group **142** opposite to the second lens group **132**.

(88) The second magnet **1632** is connected to the third lens group **142**. Specifically, the second magnet **1632** is arranged on the third housing, and the second magnet **1632** can be arranged at any position of the third housing **141**. For example, the second magnet **1632** is arranged on the surface of the third housing **141** opposite to the second housing **131**, or the second magnet **1632** is arranged on the surface of the third housing **141** opposite to the photosensitive element **50**, etc. In this embodiment, the second magnet **1632** is arranged on the surface of the third housing **141** opposite to the photosensitive element **50**, and the second magnet **1632** can be installed on the second housing **131** by gluing, screwing, clamping, etc. The second magnet **1632** may be a metal having magnetism. For example, the second magnet **1632** may be any one of iron, cobalt and nickel, or the second magnet **1632** may be an alloy composed of at least two of iron, cobalt and nickel.

(89) In other embodiments, the first coil **1621** is arranged at any position of the second housing **131**. For example, the first coil **1621** is arranged on the surface of the second housing **131** opposite to the third housing **141**, or the first coil **1621** is arranged on the surface of the second housing **131** opposite to the first lens assembly **12**, etc. The first magnet **1622** is arranged on the first side plate **1121** or the second side plate **1122**. For example, the first magnet **1622** is arranged on the first side plate **1121**, specifically, the first magnet **1622** is arranged on the inner side of the first side plate **1121** and is located between the second lens group **132** and the third lens group **142**.

(90) The second coil **1631** is arranged at any position of the third housing **141**. For example, the second coil **1631** is arranged on the surface of the third housing **141** opposite to the second housing **131**, or the second coil **1631** is arranged on the surface of the third housing **141** opposite to the photosensitive element **50**, etc. The second magnet **1632** is arranged on the first side plate **1121** or the second side plate **1122**. For example, the second magnet **1632** is arranged on the first side plate **1121**, specifically, the second magnet **1632** is arranged on the inner side of the first side plate **1121** and is located on the side of the third lens group **142** opposite to the second lens group **132**.

(91) Referring to FIG. **3**, FIG. **4**, FIG. **7***a* and FIG. **7***b*, in some embodiments, the first driving component **162** and the second driving component **163** can also include linear motors. A stator of the first linear motor of the first driving component **162** can be fixedly installed on the inner surface of the side plate **112**, a mover of the first linear motor extends from the stator and is connected to the second housing **131**, and a stator of the second linear motor of the second driving component **163** is also fixedly installed on the inner surface of the side plate **112**, a mover of the second linear motor extends from the stator and is connected to the third housing **141**. When the mover of the first linear motor makes a linear telescopic movement, it drives the second housing **131** to move linearly along the optical axis O. when the mover of the second linear motor makes a linear telescopic movement, it drives the third housing **141** to move linearly along the optical axis O. Of course, the first driving component **162** and the second driving component **163** can also be other structures, such as hydraulic structure, piezoelectric motor, etc., which will not be listed one by one here.

(92) Referring to FIGS. **3**, **4**, **7***a* and **7***b*, the anti-shake driving component **164** includes a motor **1641** and a connecting frame **1642**. An end of the connecting frame **1642** is connected to the motor **1641**, and another end is connected to the housing **11**. The connecting frame **1642** is fixedly connected to the mounting table **151** of the prism assembly **15**, and the mounting table **151** is in contact with the bearing surface **1111**.
(93) The motor **1641** may be a stepping motor. The motor **1641** is configured to drive the connecting frame **1642** to move in the first direction to drive the prism assembly **15** to move in the first direction, and the motor is further configured to drive the connecting frame **1642** to move in the second direction to drive the prism assembly **15** to move in the second direction.
(94) Referring to FIGS. **5** and **6**, the first driving chip **161** includes a first control end **1611**, a second control end **1612**, a third control end **1613** and a fourth control end **1614**. The first driving chip **161** is connected to both the first driving component **162** and the second driving component **163**. The first control end **1611** is connected to the second lens assembly through the first driving component **161**. Specifically, the first control end **1611** is connected to the first coil **1621**. The second control end **1612**, the third control end **1613** and the fourth control end **1614** are connected to the second coil **1631**. The first driving chip **161** is arranged on the base plate **111**. For example, the base plate **111** itself is a circuit board, and the first driving chip **161** is a part of the circuit board. Wiring can be carried out in the housing **11** to realize the connection of the first driving chip **161**, the first coil **1621** and the second coil **1631**. The first driving chip **161** realizes the connection with the second lens assembly **13** and the third lens assembly **14** through a magnetic connection between the first coil **1621** and the first magnet **1622** and a magnetic connection between the second coil **1631** and the second magnet **1632**.
(95) The first driving chip **161** includes a plurality of pins. A number of effective control bits of the first driving chip **161** is greater than or equal to 10, thereby a minimum moving unit of each of the second lens assembly **13** and the third lens assembly **14** meets a predetermined moving accuracy, the minimum moving unit is a minimum distance that the first driving chip **161** can control each moving of the second lens assembly **13** and/or the third lens assembly **14**, and a minimum moving unit corresponding to the predetermined moving accuracy may be 0.5 μm, 1 μm, 2 μm, etc. In this embodiment, the minimum moving unit corresponding to the predetermined moving accuracy is 0.5 μm. For example, the number of the effective control bits of the first driving chip **161** may be 10, 11, 12, 13, 14, 15, 16, etc. The number of the effective control bits is a number of pins (hereinafter referred to as first control pin) in all pins of the first driving chip **161** that can be used to control the moving of the lens assembly (such as the second lens assembly **13** and/or the third lens assembly **14**). For example, the number of pins in the first driving chip **161** that can be used to control the moving of the lens assembly is 10 (i.e., the number of first control pins is 10), the number of the effective control bits of the first driving chip **161** is 10.
(96) The first driving chip **161** controls signal outputs of the first control end **1611**, the second control end **1612**, the third control end **1613** and the fourth control end **1614** through 10 number of first control pins. For example, the first driving chip **161** can output current signals, voltage signals, etc. to the first control end **1611**, the second control end **1612**, the third control end **1613** and the fourth control end **1614**. In this embodiment, the first driving chip **161** can output current signals to the first control end **1611**, the second control end **1612**, the third control end **1613** and the fourth control end **1614**.
(97) The second driving chip **166** is configured to control the movement of the zoom lens **10** in the first direction and the second direction to achieve the optical image stabilization, and the first direction is perpendicular to the second direction. The first direction is parallel to the bearing surface **1111** and perpendicular to the optical axis O (that is, the first direction is a direction parallel to the Y direction of the zoom lens **10**), and the second direction is perpendicular to the bearing surface **1111** (that is, the second direction is a direction parallel to the Z direction of the zoom lens **10**), that is, every two of the optical axis O, the first direction and the second direction are

perpendicular to each other. In this way, the zoom lens **10** can change the deviation of the optical path caused by user shake by controlling the prism assembly **15** to move in the first and second directions perpendicular to the optical path O, thereby to offset the influence of the user shake on capturing and realize the optical image stabilization. The zoom lens **10** realizes the optical image stabilization of the zoom lens alone through the second driving chip **166**. Since the overall moving distance range of the zoom lens **10** is also small during the optical image stabilization, the second driving chip **166** can control the movement of the zoom lens with high precision even if there are few effective control bits, and thereby to realize the optical image stabilization.

(98) The second driving chip **166** includes a first anti-shake control end **1661** and a second anti-shake control end **1662**. The first anti-shake control end **1661** and the second anti-shake control end **1662** are connected to the anti-shake driving component **164**. The second driving chip **166** can also be arranged on the base plate **111** and connected to the motor **1641** by wiring on the side plate **112**. In other embodiments, the second driving chip **166** may be directly arranged on the motor **1641**.

(99) Specifically, the first anti-shake control end **1661** and the second anti-shake control end **1662** are connected to the motor **1641**. The first anti-shake control end **1661** controls the zoom lens **10** to move in the first direction by controlling the motor **1641**, and the second anti-shake control end **1662** controls the zoom lens **10** to move in the second direction by controlling the motor **1641**, and thereby to compensate the shake of the zoom lens **10** and realize the optical image stabilization.

(100) The second driving chip **166** includes a plurality of pins. A number of effective control bits of the second driving chip **166** is greater than or equal to 10. For example, the number of the effective control bits of the second driving chip **166** may be 10, 11, 12, 13, 14, 15, 16, etc. The number of effective control bits is a number of pins (hereinafter referred to as the second control pin) in all pins of the second driving chip **166** that can be used to control the overall movement of the zoom lens **10**. For example, the number of pins in the second driving chip **166** that can be used to control the overall movement of the zoom lens **10** is 10 (that is, the number of second control pins is 10), the number of the effective control bits of the second driving chip **166** is 10.

(101) The second driving chip **166** controls signal outputs of the first anti-shake control end **1661** and the second anti-shake control end **1662** through 10 number of second control pins. For example, the second driving chip **166** can output current signals, voltage signals, etc. to the first anti-shake control end **1661** and the second anti-shake control end **1662**. In this embodiment, the second driving chip **166** can output current signals to the first anti-shake control end **1661** and the second anti-shake control end **1662**.

(102) In an embodiment of the present disclosure, during the zooming, an accuracy required by the zoom lens **10** is low, for example, 2 μm, the first control end **1611** and the second control end **1612** control the second lens assembly **13** and the third lens assembly **14** to move at least 2 μm, each time different current signals are output. The first driving chip **161** can output 2.sup.10 number of different current signals through 10 number of first control pins, that is, the first control end **1611** and the second control end **1612** each can output 2.sup.10 number of different current signals, the maximum moving distance ranges of the second lens assembly **13** and the third lens assembly **14** during the zooming each is 2.sup.10*2=4096 μm. That is, the maximum distances between the starting point and the end point of the moving distance of the respective second lens assembly **13** and the third lens assembly **14** may be 4096 μm.

(103) In an embodiment of the present disclosure, during the focusing and performing optical image stabilization, the moving accuracy of the zoom lens **10** during the focusing and performing optical image stabilization needs to be less than or equal to 0.5 μm to ensure the accuracy of the zoom lens **10** in the focusing and performing optical image stabilization, and adjust the errors caused by the low zoom accuracy. For example, the moving accuracy of the zoom lens **10** during focusing is equal to 0.5 μm. It indicates that when the third control end **1613** and the fourth control end **1614** output different current signals each time, the third lens assembly **14** needs to move at least 0.5 μm. When the first anti-shake control end **1661** and the second anti-shake control end

1162 output different current signals each time, the zoom lens **10** as a whole should move at least 0.5 μm. The first driving chip **161** can output 2.sup.10 number of different current signals through 10 number of first control pins, that is, the third control end **1613** and the fourth control end **1614** each can output 2.sup.10 number of different current signals, therefore the maximum moving distance range of the third lens assembly **14** during focusing is 2.sup.10*0.5=512 μm. That is, the maximum distances between the starting point and the end point of the moving distance of the second lens assembly **13** and the third lens assembly **14** may be 512 μm. The second driving chip **166** can also output 2.sup.10 number of different current signals through 10 number of second control pins, that is, the first anti-shake control end **1661** and the second anti-shake control end **1662** can output 2.sup.10 number of different current signals, therefore the maximum travel range of the zoom lens **10** is 2.sup.10*0.5=512 μm. That is, the maximum distance between the starting point and the end point of the moving distance of the zoom lens **10** in the first direction or the second direction can be 512 μm.

(104) Referring to FIG. **5**, FIG. **7***a* and FIG. **7***b*, when a user captures images with the electronic device **1000**, the user can manually select a long focus mode or a short focus mode. The long focus mode is usually used to capture distant objects with small viewing range, and the short focus mode (commonly known as wide-angle mode) is usually used to capture nearby objects with large viewing range. When the user selects a required capturing mode, a processor of the mobile phone will send a control command. After receiving the control command, the first driving chip **161** starts to control the second lens assembly **13** and the third lens assembly **14** to move relative to the first lens assembly **12** along the optical axis O, thereby to realize the switching of the zoom lens **10** between the first target focal length and the second target focal length. The first target focal length may be in the short focus state, and the second target focal length may be in the long focal state.

(105) Specifically, the first control end **1611** outputs a current signal to control a current inputted into the first coil **1621**. When the first coil **1621** is energized, a Lorentz force is generated between the first coil **1621** and the first magnet **1622**. When the Lorentz force is greater than the static friction between the second lens assembly **13** and the slide rail, the first magnet **1622** is pushed by the Lorentz force to drive the second lens assembly **13** to move along the first slide rail **1113** and the second slide rail **1114**. The first control end **1611** can control the direction of the Lorentz force by controlling the direction of the current inputted into the first coil **1621**, and thereby the second lens assembly **13** moves in the X direction or the opposite direction of the X direction. With the change of the current signal outputted by the first driving chip **161**, the current inputted into the first coil **1621** changes at the same time, the second lens assembly **13** can move in a fixed moving distance range (hereinafter referred to as a first moving distance range. For example, the first moving distance range is section AB of the slide rail in FIG. **9***a* and FIG. **9***b*, which is [0 μm, 4096 μm]). As the current inputted in first coil **1621** changes, the moving distance of the second lens assembly **13** also changes, in which a corresponding relationship of the moving distance S (unit: μm) with current I (unit: milliampere (ma)) is shown in FIG. **10**. The moving distance corresponding to position A is 0 μm and the moving distance corresponding to position B is 4096 μm. It can be understood that when the use state of the mobile phone is different, the Lorentz force required to move the second lens assembly **13** is different, and the corresponding current required is also different. For example, when the mobile phone is in the vertical state (i.e., perpendicular to the ground), if the second lens assembly **13** moves in the direction close to the ground (i.e., the opposite direction of the X direction), the Lorentz force F**1** plus the gravity of the second lens assembly **13** is greater than the static friction between the second lens assembly **13** and the slide rail to drive the second lens assembly **13** to move. At this time, the required Lorentz force F**1** is small, as shown in curve S**1** in FIG. **10**. When the moving distance of the second lens assembly **13** begins to change, the corresponding current I**1** is small. When the second lens assembly **13** moves away from the ground (i.e., the X direction), the Lorentz force F**2** is greater than the gravity of the second lens assembly **13** plus the static friction between the second lens assembly **13** and the slide

rail to drive the second lens assembly **13** to move. At this time, the required Lorentz force F**2** is large, as shown in curve S**3** in FIG. **10**. When the moving distance of the second lens assembly **13** begins to change, the corresponding current I**2** is large. When the mobile phone is in a horizontal state (i.e., parallel to the ground), the second lens assembly **13** moves in the X direction or the opposite direction of the X direction, it only needs that the Lorentz force F**3** is greater than the static friction between the second lens assembly **13** and the slide rail. At this time, the required Lorentz force F**3** is located between the Lorentz force F**1** and the Lorentz force F**2**, as shown in curve S**2** in FIG. **10**, When the moving distance of the second lens assembly **13** begins to change, the corresponding current I**3** is located between the current I**1** and the current I**2**. In this way, the moving distance of the second lens assembly **13** can be controlled by controlling the current inputted into the first coil **1621** through the first control end **1611**.
(106) The second control end **1612** outputs a current signal to control a current inputted into the second coil **1631**. When the second coil **1631** is energized, a Lorentz force is generated between the second coil **1631** and the second magnet. When the Lorentz force is greater than the static friction between the third lens assembly **14** and the slide rail, the second magnet is pushed by the Lorentz force to drive the third lens assembly **14** to move along the first slide rail and the second slide rail, the second control end **1612** can control the direction of the Lorentz force by controlling the direction of the current inputted into the second coil **1631**, thereby the third lens assembly **14** moves in the X direction or the opposite direction of the X direction. With the change of the current signal outputted by the first driving chip **161**, the current inputted into the second coil **1631** changes at the same time, the third lens assembly **14** can move in a fixed moving distance range (hereinafter referred to as the second moving distance range. For example, the second moving distance range is the section CD of the slide rail in FIG. **9***a*, which is [0 μm, 4096 μm]), as the current inputted in the second coil **1631** changes, the moving distance of the third lens assembly **14** also changes. The corresponding relationship between a moving distance and a current is shown in FIG. **10**, the moving distance corresponding to position C is 0 μm, and the moving distance corresponding to position D is 4096 μm. It can be understood that when the use state of the mobile phone is different, the Lorentz force required to move the third lens assembly **14** is different, and the corresponding current is also different. Since the changes of the Lorentz force and corresponding current required to move the third lens assembly **14** are basically the same as the changes of the Lorentz force and the corresponding current required to move the second lens assembly **13**, please refer to the above description for specific explanation, which will not be repeated here. In this way, the moving distance of the third lens assembly **14** can be controlled by controlling the current inputted into the second coil **1631** through the second control end **1612**.
(107) In the long focus state and the short focus state, the second lens assembly **13** and the third lens assembly **14** correspond to different moving distances respectively. For example, in the long focus state, the moving distances of the second lens assembly **13** and the third lens assembly **14** are p**0** and m**0**, respectively. In the short focus state, the moving distances of the second lens assembly **13** and the third lens assembly **14** are p**1** and m**1** respectively, p**0** and p**1** are within the first moving distance range, and m**0** and m**1** are within the second moving distance range.
(108) According to the current state of the mobile phone (such as vertical state or horizontal state) and the moving direction of the lens assembly (such as the second lens assembly **13** and the third lens assembly **14**), a mapping curve of the moving distance S and the current I can be determined. For example, when the mobile phone is in the horizontal state, the currents I**4** and I**5** corresponding to p**0** and p**1** and the currents I**6** and I**7** corresponding to m**0** and m**1** can be determined according to the mapping curve S**2**. For example, the second lens assembly **13** is initially in position A, the third lens assembly **14** is initially located at position C. The first control end **1611** controls the current inputted into the first coil **1621** to be I**4**, and the second control end **1612** controls the current inputted into the second coil **1631** to be I**6**, which can move the second lens assembly **13** to position p**0** and the third lens assembly **14** to position m**0**, thereby to switch the zoom lens **10** to the

long focus state. Similarly, the second lens assembly **13** is initially at position A, and the third lens assembly **14** is initially at position C. The first control end **1611** controls the current inputted into the first coil **1621** to be IS, and the second control end **1612** controls the current inputted into the second coil **1631** to be I7, which can move the second lens assembly **13** to position p**1** and the third lens assembly **14** to position m**1**, and thereby to switch the zoom lens **10** to the short focus state.

(109) In an embodiment of the present disclosure, a first axial spacing z**11** between the first lens group **122** and the second lens group **132** when the zoom lens **10** is in the short focus state (as shown in FIG. **7***a*) is greater than a first axial spacing z**12** between the first lens group **122** and the second lens group **132** when the zoom lens **10** is in the long focus state (as shown in FIG. **7***b*). A second axis spacing z**21** between the second lens group **132** and the third lens group **142** when the zoom lens **10** is in the short focus state is greater than a second axis spacing z**22** between the second lens group **132** and the third lens group **142** when the zoom lens **10** is in the long focus state. That is, when the zoom lens **10** changes from the short focus state to the long focus state, the second lens group **132** moves close to the first lens group **122** (the first axis spacing decreases), the third lens group **142** moves close to the second lens group **132**, and the second axis spacing decreases. In other embodiments, the first axis spacing z**11** when the zoom lens **10** is in the short focus state is less than the first axis spacing z**12** when the zoom lens **10** is in the long focus state, and the second axis spacing z**21** when the zoom lens **10** is in the short focus state is less than the second axis spacing z**22** when the zoom lens **10** is in the long focus state. In at least one alternative embodiment, the first axis spacing z**11** when the zoom lens **10** is in the short focus state is less than the first axis spacing z**12** when the zoom lens **10** is in the long focus state, the second axis spacing z**21** when the zoom lens **10** is in the short focus state is greater than the second axis spacing z**22** when the zoom lens **10** is in the long focus state, etc. When the zoom lens **10** is switched from the short focus state to the long focus state, variation trends of the first axis spacing z**1** and the second axis spacing z**2** can be determined according to parameters (such as surface parameters, aspherical coefficient parameters, etc.) of the first lens group **122** to the third lens group **142**, which will not be listed one by one here.

(110) It can be understood that the variation range of the focal length of the zoom lens **10** is different according to decreasing ranges of the first axis spacing and the second axis spacing. For example, the focal length of the zoom lens **10** gradually increases as the first axis spacing and the second axis spacing gradually decrease. For another example, as the first axis spacing and the second axis spacing gradually decrease, the focal length of the zoom lens **10** gradually increases, etc. In this embodiment, as the first axis spacing and the second axis spacing gradually decrease, the focal length of the zoom lens **10** gradually increases. In this way, the zoom lens **10** can control a gradual change of a multiple of the focal length. For example, with the gradual decreases of the first axis spacing and the second axis spacing, the focal length gradually changes from one time of the initial focal length to 10 times of the initial focal length (the initial focal length is the focal length when the zoom lens **10** is in the short focus state), therefore the zoom lens **10** can achieve 10 times optical zoom.

(111) It can be understood that during the zooming, the moving distance ranges of the second lens assembly **13** and the third lens assembly **14** are large, due to the limitation of the effective control bits of the first driving chip **161**, the moving accuracy of the second lens assembly **13** and the third lens assembly **14** controlled by the first control end **1611** and the second control end **1612** during the zooming will be lower than the accuracy required for focusing. After the zooming is completed, high precision focusing can be carried out to ensure accurate focal length adjustment of the zoom lens **10**, and thereby to improve the imaging quality.

(112) After the zoom lens **10** completes the zooming, the mobile phone can obtain the image of the subject through the camera module **100**, and judge whether a definition of the image reaches a preset definition in real time. The definition of the image can be obtained by calculating a contrast ratio of the image. During the capturing image, the light successively passes through the light inlet

1131 of the cover plate **113**, the light inlet through hole **153** of the prism assembly **15**, is reflected by the reflecting surface **157** of the prism **152**, and is emitted from the light outlet through hole **154**. Then, the light successively passes through the light inlet **123**, the first lens group **122**, and the light outlet **124** of the first lens assembly **12**, the first light inlet **135**, the second lens group **132**, and the first light outlet **136** of the second lens assembly **13**, and the second light inlet **145**, the third lens group **142** and the second light outlet **146**, reaches the photosensitive element **50** for capturing image.
(113) In response to the definition of the image does not reach the preset definition, it means that the focal length at this time cannot make the subject clear imaging. At this time, the focusing is required. The focusing is to slightly adjust the focal length, compared with the large-scale adjustment of the focal length, the focusing will not change the current state (such as short focus state or long focus state) of the zoom lens **10**.
(114) During the focusing, for example, the zoom lens **10** is in a short focus state (i.e., as shown in FIG. **9***a*, the second lens assembly **13** is located at position p**0** and the third lens assembly **14** is located at position m**0**), and the third control end **1613** controls the current inputted to the second coil **1631** to make the third lens group starts moving with p**0** as the starting position and moves with the minimum moving accuracy (e.g., 0.5 μm) each time. For example, the moving distance range of the focusing is [0 μm, 512 μm] (as shown in FIG. **9***a*, position E and position F respectively correspond to 0 μm and 512 μm, position m**0** corresponds to 256 μm), the third control end **1613** can control the third lens assembly **14** to move in the X direction every time (i.e., move 0.5 μm). That is, obtaining the definition of the image of the subject once and judging whether the definition reaches the preset definition. If the definition does not reach the preset definition until it moves to the position E, controlling the third lens assembly **14** to quickly move to the position m**0** (for example, controlling the current inputted into the second coil **1631** just to make the third lens assembly **14** move 256 μm in the opposite direction of the X direction), and the third lens assembly **14** is controlled to continue moving to the position F in the opposite direction of the X direction until the definition of the image of the subject reaches the preset definition. At this time, the third control end **1613** controls the third lens assembly **14** to stop moving.
(115) During the focusing, for example, the zoom lens **10** is in the long focus state (i.e., as shown in FIG. **9***b*, the second lens assembly **13** is at position p**1** and the third lens assembly **14** is at position m**1**), and the fourth control end **1614** controls the current inputted into the second coil **1631** to make the third lens group starts moving with p**1** as the starting position and moves with the minimum moving accuracy (e.g., 0.5 μm) each time. For example, the moving distance range of the focusing is [0 μm, 512 μm] (as shown in FIG. **9***b*, position G and position H respectively correspond to 0 μm and 512 μm, position m**1** corresponds to 256 μm), the fourth control end **1614** can control the third lens assembly **14** to move in the X direction every time (i.e., move 0.5 μm). That is, obtaining the definition of the image of the subject once and judging whether the definition reaches the preset definition. If the definition does not reach the preset definition until it moves to the position G, controlling the third lens assembly **14** to quickly move to the position m**1** (for example, controlling the current inputted to the second coil **1631** just to make the third lens assembly **14** move 256 μm in the opposite direction of the X direction). Then, the third lens assembly **14** is controlled to continue to move to the position H in the opposite direction of the X direction until the definition of the image of the subject reaches the preset definition. At this time, the fourth control end **1614** controls the third lens assembly **14** to stop moving. In this way, the focusing of the zoom lens **10** in the short focus state and the long focus state can be accurately completed, and since the moving distance range during the focusing in the short focus state and the long focus state is small, the effective control bits of the first driving chip **161** are less (such as 10 bits), and the high-precision movement of the third lens assembly **14** can be controlled (at least 0.5 μm can be moved each time), and thereby to ensure the accuracy of focusing.
(116) During the capturing images with the mobile phone, because the user generally does not use a

stabilizer (such as a handheld stabilizer, etc.), the user's hand shake may cause the zoom lens **10** to be affected by the shake and make the captured image blurred. The mobile phone is generally equipped with a gyroscope to detect the user shake. After obtaining the user shake data, the processor can generate a corresponding movement control command and send it to the second driving chip **166**. The second driving chip **166** controls the motor **1641** to drive the connecting frame **1642** to move in the first direction through the fourth control end **1661** and the fifth control end **1662** to drive the zoom lens **10** to move in the first direction, and controls the motor **1641** to drive the connecting frame **1642** to move in the second direction to drive the zoom lens **10** to move in the second direction, and thereby to offset the impact of user shake on capturing images and realize the optical image stabilization.
(117) Referring to FIGS. **5** and **11**, in some embodiments, the zoom lens **10** further includes a fourth lens assembly **17** arranged in the housing **11**, and the second driving chip **166** further includes a fifth control end **1663** configured to control the fourth lens group **17** to move relative to the first lens group **12** along the optical axis O.
(118) Specifically, in order to change the focal length in a wider range, such as 50 times optical zoom, the zoom lens **10** can be provided with a movable fourth lens assembly **17**. The first lens assembly **12**, the second lens assembly **13**, the third lens assembly **14** and the fourth lens assembly **17** are arranged in sequential order along the optical axis O. The fourth lens assembly **17** is controlled to move in the X direction or the opposite direction of the X direction through the fifth control end **1663**, and thereby to achieve a larger range change of focus length.
(119) Referring to FIG. **12**, in some embodiments, the cover plate **113** may also include a cover plate body **1132** and a boss **1133**, the boss **1133** is connected to the cover plate body **1132**, the first lens assembly **12** is arranged in the boss **1133**, and the first lens group **122** of the first lens assembly **12** is opposite to the incident surface **156** of the prism **152**.
(120) Specifically, the boss **1133** is provided with a mounting space **1135**, the mounting space **1135** is connected to the receiving space **114**, the first lens assembly **12** is arranged in the mounting space **1135**, and the first lens assembly **12** forms an optical axis O′, which is perpendicular to the optical axis O. The first lens assembly **12** can be installed in the mounting space **1135** by gluing, screwing, clamping, etc., and the first lens assembly **12** can also be integrally formed with the boss **1133**. The end face of the boss **1133** facing away from the prism assembly **15** is provided with an optical inlet **1131**, and the depth direction of the optical inlet **1131** can be parallel to the optical axis O′, and thus the camera module **100** has a periscopic structure as a whole. The light inlet **1131** is opposite to the light inlet hole **123** of the first housing **121**, and the light outlet hole **124** is opposite to the light inlet through hole **153** of the prism assembly **15**. In this way, the length of the zoom lens **10** in a certain direction (such as the X direction) can be reduced.
(121) Referring to FIGS. **4**, **7***a* and **7***b*, in some embodiments, the first top surface **138** is provided with a second groove **1381**, and the second lens assembly **13** includes a second ball **134**, which is arranged in the second groove **1381** and in contact with the cover plate **113**.
(122) Specifically, the second groove **1381** matches a shape of the second ball **134**. For example, the second ball **134** is spherical and has low moving resistance, the second groove **1381** is a semicircular groove, and a diameter of the second ball **134** is equal to that of the second groove **1381**, that is, a half of the second ball **134** is located in the second groove **1381**. The second ball **134** and the second groove **1381** are closely combined. When the second ball **134** moves, it can drive the second housing **131** of the second lens assembly **13** to move. A number of the second groove **1381** is one or more. For example, the number of the second groove **1381** is one, two, three, four, or even more. In this embodiment, the number of the second groove **1381** is three. A number of the second ball **134** may also be one or more. In this embodiment, the number of the second ball **134** is the same as the number of the second groove **1381**, and there are also three. The three second grooves **1381** are spaced on the first top surface **138** of the second housing **131**. The second ball **134** is arranged in the second groove **1381** and in contact with the cover plate **113**, the second

lens assembly **13** is limited between the cover plate **113** and the base plate **111**, which can prevent the second lens assembly **13** from shaking or tilting in the Z direction, thereby to ensure that the imaging quality is not affected.
(123) Referring to FIGS. **4**, **7***a* and **7***b*, in some embodiments, a slideway **1134** is formed on the surface of the cover plate **113** opposite the first top surface **138**, and the second ball **134** is arranged in the second groove **1381** and in contact with the bottom of the slideway **1134**.
(124) Specifically, the slideway **1134** may be a groove with an extension direction parallel to the X direction formed on the surface of the cover plate **113** opposite to the first top surface **138**, the slideway **1134** may also be a bump with an extension direction parallel to the X direction arranged on the surface opposite to the first top surface **138** of the cover plate **113**, and a groove matched with the second ball **134** is formed on the surface of the bump opposite to the first top surface **138** of the second housing **131**. In this embodiment, the slideway **1134** is a groove with the extension direction parallel to the X direction formed on the surface of the cover plate **113** opposite to the first top surface **138**. After the second lens assembly **13** is installed in the receiving space **114**, a part of the second ball **134** is located in the slideway **1134** and in contact with the bottom of the slideway **1134**. The shape of the inner wall of the slideway **1134** cut by the plane perpendicular to the X direction is a third arc, the outer contour of the second ball **134** cut by the plane perpendicular to the X direction is a fourth arc, and the curvature of the third arc is the same as that of the fourth arc. Thus, in the Y direction, the outer wall of the second ball **134** is closely combined with the inner wall of the slideway **1134**, and the opposite sides of the outer wall of the second ball **134** are in contact with the opposite sides of the inner wall of the slideway **1134**.
(125) A number of the slideway **1134** can be determined according to the position of the three second grooves **1381**. For example, if the connecting line of the three second grooves **1381** is parallel to the optical axis O, only one slideway **1134** needs to be set. For another example, the three second grooves **1381** are divided into two groups (hereinafter referred to as a fifth group and a sixth group). The fifth group includes one second groove **1381**, the sixth group includes two second grooves **1381**, and the second groove **1381** of the fifth group is not on the connecting line of the two second grooves **1381** of the sixth group (that is, the three second grooves **1381** can form a triangle), two slideways **1134** are required to correspond to the fifth group and the sixth group respectively. In this embodiment, the three second grooves **1381** are divided into the fifth group and the sixth group. The fifth group includes one second groove **1381**, the sixth group includes two second grooves **1381**, and the number of the slideway **1134** is two (hereinafter referred to as the first slideway **1157** and the second slideway **1158**). The fifth group corresponds to the first slideway **1157**, and the sixth group corresponds to the second slideway **1158**. In this way, the second ball **134** corresponding to the fifth group slides in the first slideway **1157**, the second balls **134** corresponding to the sixth group slide in the second slideway **1158**, the second ball **134** corresponding to the fifth group and the second balls **134** corresponding to the sixth group are limited in the first slideway **1157** and the second slideway **1158** respectively, and the three second balls **134** form a triangle to minimize the number of the second ball **134**, on the premise of ensuring sliding stability, it can reduce the sliding resistance. Moreover, in the Y direction, the opposite sides of the outer wall of the second ball **134** corresponding to the fifth group are in contact with the opposite sides of the inner wall of the first slideway **1157**, and the opposite sides of the outer wall of each second ball **134** corresponding to the sixth group are in contact with the opposite sides of the inner wall of the second slideway **1158**. The three second balls **134** form a triangle, which can prevent the second lens assembly **13** from shaking or tilting in the Y direction, thus, the imaging quality of the camera module **100** is not affected.
(126) Referring to FIGS. **4**, **7***a* and **7***b*, in some embodiments, the second top surface **148** is provided with a fourth groove **1481**, and the third lens assembly **14** includes a fourth ball **144**, which is arranged in the fourth groove **1481** and in contact with the cover plate **113**.
(127) Specifically, the fourth groove **1481** matches a shape of the fourth ball **144**. For example, the

fourth ball **144** is spherical and has low moving resistance, the fourth groove **1481** is a semicircular groove, and a diameter of the fourth ball **144** is equal to that of the fourth groove **1481**, that is, a half of the fourth ball **144** is located in the fourth groove **1481**. The fourth ball **144** and the fourth groove **1481** are closely combined. When the fourth ball **144** moves, it can drive the third housing **141** of the third lens assembly **14** to move. A number of the fourth groove **1481** is one or more. For example, the number of the fourth groove **1481** is one, two, three, four, or even more. In this embodiment, the number of the fourth groove **1481** is three. A number of the fourth ball **144** may also be one or more. In this embodiment, the number of the fourth ball **144** is the same as the number of the fourth groove **1481**, and there are also three. The three fourth grooves **1481** are spacing on the top surface **148** of the third housing **141**. The fourth ball **144** is arranged in the fourth groove **1481** and in contact with the cover plate **113**, the third lens assembly **14** is limited between the cover plate **113** and the base plate **111**, which can prevent the third lens assembly **14** from shaking or tilting in the Z direction, and thereby to ensure that the imaging quality is not affected.

(128) Referring to FIGS. **4**, **7***a* and **7***b*, in some embodiments, a slideway **1134** is formed on the surface of the cover plate **113** opposite the second top surface **148**, and the fourth ball **144** is arranged in the fourth groove **1481** and in contact with the bottom of the slideway **1134**.

(129) After the third lens assembly **14** is installed in the receiving space **114**, a part of the fourth ball **144** is located in the slideway **1134** and in contact with the bottom of the slideway **1134**. The shape of the inner wall of the slideway **1134** cut by the plane perpendicular to the X direction is a third arc, the outer contour of the fourth ball **144** cut by the plane perpendicular to the X direction is a fourth arc, and the curvature of the third arc is the same as that of the fourth arc. In the Y direction, the outer wall of the fourth ball **144** is closely combined with the inner wall of the slideway **1134**, and the opposite sides of the outer wall of the fourth ball **144** are in contact with the opposite sides of the inner wall of the slideway **1134**.

(130) In this embodiment, the three fourth grooves **1481** are divided into a seventh group and an eighth group. The seventh group includes one fourth groove **1481**, the eighth group includes two fourth grooves **1481**, the seventh group corresponds to the first slideway **1157**, and the eighth group corresponds to the second slideway **1158**. In this way, the fourth ball **144** corresponding to the seventh group slides in the first slideway **1157**, the fourth balls **144** corresponding to the eighth group slide in the second slideway **1158**, the fourth ball **144** corresponding to the seventh group and the fourth balls **144** corresponding to the eighth group are limited in the first slideway **1157** and the second slideway **1158** respectively, and the three fourth balls **144** form a triangle, and thereby to minimize the number of the fourth ball **144** on the premise of ensuring sliding stability, it can reduce the sliding resistance. Moreover, in the Y direction, the opposite sides of the outer wall of the fourth ball **144** corresponding to the seventh group are in contact with the opposite sides of the inner wall of the first slideway **1157**, and the opposite sides of the outer wall of each fourth ball **144** corresponding to the eighth group are in contact with the opposite sides of the inner wall of the second slideway **1158**. The three fourth balls **144** form a triangle, which can prevent the second lens assembly **13** from shaking or tilting in the Y direction, thus, the imaging quality of the camera module **100** is not affected.

(131) In the description of this specification, the description referring to the terms “some embodiments”, “an embodiment”, “one embodiments”, “illustrated embodiments”, “examples”, “specific examples”, or “some examples” means that the specific features, structures, materials or characteristics described in combination with the embodiments or examples are included in at least one embodiment or example of the present disclosure. In this specification, the schematic expression of the above terms does not necessarily refer to the same embodiment or example. Further, the specific features, structures, materials or characteristics described may be combined in a suitable manner in any one or more embodiments or examples.

(132) In addition, the terms “first” and “second” are only used for descriptive purposes and cannot

be understood as indicating or implying relative importance or implicitly indicating the number of indicated technical features. Thus, the features defined with “first” and “second” can include at least one feature explicitly or implicitly. In the description of the present disclosure, “a plurality of” means at least two, such as two or three, unless otherwise expressly and specifically defined.
(133) Although the embodiments of the present disclosure have been shown and described above, it can be understood that the above embodiments are exemplary and cannot be understood as restrictions on the present disclosure. Those skilled in the art can change, amend, replace and modify the above embodiments within the scope of the present disclosure. The scope of the present disclosure is limited by the claims and their equivalents.

Claims

1. A zoom lens, comprising: a housing; a first lens assembly, a second lens assembly and a third lens assembly, wherein the first lens assembly, the second lens assembly and the third lens assembly are arranged in the housing in sequential order along an optical axis of the first lens assembly; and a first driving chip, comprising: a first control end, a second control end, a third control end and a fourth control end; wherein the first control end is configured to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens, and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens; and wherein the third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length in a short focal state to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length in a long focal state to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length; a moving accuracy of the third lens assembly during the focusing is higher than a moving accuracy of each of the second lens assembly and the third lens assembly during the zooming, and a travel range of the third lens assembly during the focusing is less than a travel range of each of the second lens assembly and the third lens assembly during the zooming.
2. The zoom lens according to claim 1, wherein the housing comprises a base plate, and the base plate comprises a bearing surface; the zoom lens further comprises a second driving chip and a prism assembly; and the prism assembly, the first lens assembly, the second lens assembly and the third lens assembly are arranged on the bearing surface in sequential order along the optical axis; and wherein the second driving chip is configured to control the prism assembly to move in a first direction and a second direction, thereby to realize optical image stabilization; and every two of the optical axis, the first direction and the second direction are perpendicular to each other.
3. The zoom lens according to claim 2, wherein the first direction is parallel to the bearing surface and perpendicular to the optical axis, the second direction is perpendicular to the bearing surface, and the bearing surface is parallel to the optical axis.
4. The zoom lens according to claim 2, wherein a number of effective control bits of each of the first driving chip and the second driving chip is greater than or equal to 10, and a minimum moving unit of each of the second lens assembly and the third lens assembly meets a moving accuracy of 0.5 μm.
5. The zoom lens according to claim 2, wherein the zoom lens further comprises a fourth lens assembly arranged in the housing, the second driving chip further comprises a fifth control end, and the fifth control end is connected to the fourth lens assembly and configured to control the fourth lens assembly to move relative to the first lens assembly along the optical axis.
6. The zoom lens according to claim 2, wherein the zoom lens comprises an anti-shake driving component, the second driving chip comprises a first anti-shake control end and a second anti-

shake control end, the first anti-shake control end and the second anti-shake control end are connected to the anti-shake driving component, and the anti-shake driving component is connected to the prism assembly; wherein the first anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the first direction; and wherein the second anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the second direction.

7. The zoom lens according to claim 6, wherein the prism assembly comprises a prism, and the prism comprises an incident surface, a reflecting surface and an emitting surface connected in sequence; and wherein the first lens assembly is opposite to one of the incident surface and the emitting surface, and the reflecting surface is configured to reflect light incident into the incident surface to make the light exit from the emitting surface.

8. The zoom lens according to claim 1, wherein the zoom lens further comprises a first driving component and a second driving component; wherein the first control end is connected to the second lens assembly through the first driving component, and the first control end is configured to control the first driving component to move and thereby to drive the second lens assembly to move relative to the first lens assembly along the optical axis; and wherein the second control end, the third control end and the fourth control end are connected to the second driving component, the second driving component is connected to the third lens assembly, and the second control end, the third control end and the fourth control end are configured to control the second driving component to move and thereby to drive the third lens assembly to move relative to the first lens assembly along the optical axis.

9. The zoom lens according to claim 8, wherein the first driving component comprises a first coil and a first magnet, the second driving component comprises a second coil and a second magnet, the first magnet is connected to the second lens assembly, and the second magnet is connected to the third lens assembly; wherein the first control end is connected to the first coil, and the first control end is configured to control a current inputted to the first coil and thereby to drive the first magnet to drive the second lens assembly to move relative to the first lens assembly along the optical axis; and wherein the second control end, the third control end and the fourth control end are connected to the second coil, and the second control end, the third control end and the fourth control end are configured to control a current inputted to the second coil and thereby to drive the second magnet to drive the third lens assembly to move relative to the first lens assembly along the optical axis.

10. The zoom lens according to claim 1, wherein the housing comprises a base plate, a bearing surface of the base plate is provided with two slide rails, a surface of each of the second lens assembly and the third lens assembly opposite to the bearing surface is provided with three balls, the balls of each of the second lens assembly and the third lens assembly are slidably connected to the slide rails and thereby the second lens assembly and the third lens assembly are movable relative to the first lens assembly along the optical axis; the three balls of each of the second lens assembly and the third lens assembly define a triangle; the two slide rails comprise a first slide rail and a second slide rail, an extension direction of each of the first slide rail and the second slide rail is parallel to the optical axis; in the optical axis, a first distance between an end of the first slide rail close to the first lens assembly and the first lens assembly is greater than a second distance between an end of the second slide rail close to the first lens assembly and the first lens assembly, and a third distance between another end of the first slide rail facing away from the first lens assembly and the first lens assembly is less than a fourth distance between another end of the second slide rail facing away from the first lens assembly and the first lens assembly.

11. The zoom lens according to claim 1, wherein the third control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches a preset definition, under the first target focal length; wherein the fourth control end is further configured to control the third lens assembly to stop moving in response to a

definition of an image captured by the zoom lens reaches the preset definition, under the second target focal length.

12. A camera module, comprising: a photosensitive element and a zoom lens; wherein the photosensitive element is arranged on an image side of the zoom lens; and wherein the zoom lens comprises: a housing; a first lens assembly, a second lens assembly and a third lens assembly; and the first lens assembly, the second lens assembly and the third lens assembly being arranged in the housing in sequential order along an optical axis of the first lens assembly; and a first driving chip, comprising: a first control end, a second control end, a third control end and a fourth control end; wherein the first control end is configured to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens; and wherein the third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length in a short focal state to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length in a long focal state to realize focusing of the zoom lens, and the first target focal length is different from the second target focal length, a moving accuracy of the third lens assembly during the focusing is higher than a moving accuracy of each of the second lens assembly and the third lens assembly during the zooming, and a travel range of the third lens assembly during the focusing is less than a travel range of each of the second lens assembly and the third lens assembly during the zooming.

13. The camera module according to claim 12, wherein the housing comprises a base plate, and the base plate comprises a bearing surface; the zoom lens further comprises a second driving chip and a prism assembly; and the prism assembly, the first lens assembly, the second lens assembly and the third lens assembly are arranged on the bearing surface in sequential order along the optical axis; and wherein the second driving chip is configured to control the prism assembly to move in a first direction and a second direction, thereby to realize optical image stabilization; and every two of the optical axis, the first direction and the second direction are perpendicular to each other.

14. The camera module according to claim 13, wherein the first direction is parallel to the bearing surface and perpendicular to the optical axis, the second direction is perpendicular to the bearing surface, and the bearing surface is parallel to the optical axis; wherein a number of effective control bits of each of the first driving chip and the second driving chip is greater than or equal to 10, and a minimum moving unit of each of the second lens assembly and the third lens assembly meets a moving accuracy of 0.5 μm; or wherein the zoom lens further comprises a fourth lens assembly arranged in the housing, the second driving chip further comprises a fifth control end, and the fifth control end is connected to the fourth lens assembly and configured to control the fourth lens assembly to move relative to the first lens assembly along the optical axis.

15. The camera module according to claim 13, wherein the zoom lens comprises an anti-shake driving component, the second driving chip comprises a first anti-shake control end and a second anti-shake control end, the first anti-shake control end and the second anti-shake control end are connected to the anti-shake driving component, and the anti-shake driving component is connected to the prism assembly; and wherein the first anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the first direction; and wherein the second anti-shake control end is configured to control the anti-shake driving component to move and thereby to drive the prism assembly to move in the second direction.

16. The camera module according to claim 15, wherein the prism assembly comprises a prism, and the prism comprises an incident surface, a reflecting surface and an emitting surface connected in sequence; and wherein the first lens assembly is opposite to one of the incident surface and the emitting surface, and the reflecting surface is configured to reflect light incident into the incident

surface to make the light exit from the emitting surface.

17. The camera module according to claim 13, wherein the zoom lens further comprises a first driving component and a second driving component; wherein the first control end is connected to the second lens assembly through the first driving component, and the first control end is configured to control the first driving component to move and thereby to drive the second lens assembly to move relative to the first lens assembly along the optical axis; and wherein the second control end, the third control end and the fourth control end are connected to the second driving component, the second driving component is connected to the third lens assembly, and the second control end, the third control end and the fourth control end are configured to control the second driving component to move and thereby to drive the third lens assembly to move relative to the first lens assembly along the optical axis.

18. The camera module according to claim 17, wherein the first driving component comprises a first coil and a first magnet, the second driving component comprises a second coil and a second magnet, the first magnet is connected to the second lens assembly, and the second magnet is connected to the third lens assembly; wherein the first control end is connected to the first coil, and the first control end is configured to control a current inputted to the first coil and thereby to drive the first magnet to drive the second lens assembly to move relative to the first lens assembly along the optical axis; and wherein the second control end, the third control end and the fourth control end are connected to the second coil, and the second control end, the third control end and the fourth control end are configured to control a current inputted to the second coil and thereby to drive the second magnet to drive the third lens assembly to move relative to the first lens assembly along the optical axis.

19. The camera module according to claim 12, wherein the housing comprises a base plate, a bearing surface of the base plate is provided with a slide rail, surfaces of the second lens assembly and the third lens assembly opposite to the bearing surface are provided with balls, the balls of the second lens assembly and the third lens assembly are slidably connected to the slide rail and thereby the second lens assembly and the third lens assembly are movable relative to the first lens assembly along the optical axis; or wherein the third control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches a preset definition, under the first target focal length; the fourth control end is further configured to control the third lens assembly to stop moving in response to a definition of an image captured by the zoom lens reaches the preset definition, under the second target focal length; and the first target focal length is in a short focal state, and the second target focal length is in a long focal state.

20. An electronic device, comprising: a casing; and a camera module; wherein the camera module is installed in the casing and comprises: a photosensitive element and a zoom lens, the photosensitive element is arranged on an image side of the zoom lens; and wherein the zoom lens comprises: a housing; a first lens assembly, a second lens assembly and a third lens assembly; and the first lens assembly, the second lens assembly and the third lens assembly being arranged in the housing in sequential order along an optical axis of the first lens assembly; and a first driving chip, comprising: a first control end, a second control end, a third control end and a fourth control end; wherein the first control end is configured to control the second lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens and the second control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis to realize zooming of the zoom lens; and wherein the third control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a first target focal length in a short focal state to realize focusing of the zoom lens, the fourth control end is configured to control the third lens assembly to move relative to the first lens assembly along the optical axis under a second target focal length in a long focal state to realize focusing of the zoom lens, and the first target focal length is different from the second target

focal length; a moving accuracy of the third lens assembly during the focusing is higher than a moving accuracy of each of the second lens assembly and the third lens assembly during the zooming, and a travel range of the third lens assembly during the focusing is less than a travel range of each of the second lens assembly and the third lens assembly during the zooming.