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Optical system, image capturing module, and electronic device

Abstract

An optical system includes a first lens having a positive refractive power; a second lens having a refractive power; a third lens having a negative refractive power and an object side surface and an image side surface being concave at circumferences; a fourth lens having a negative refractive power; a fifth lens having a positive refractive power and an object side surface and an image side surface being aspherical, and at least one of the object side surface and the image side surface having an inflection point; and a sixth lens having a negative refractive power. $0.60 < CT1/SD11 < 1.01$; $5.5 < TTL/CT1 < 9.0$; $CT1$ is a thickness of the first lens, $SD11$ is half of a maximum effective aperture of an object side surface of the first lens, TTL is a distance from the object side surface of the first lens to an imaging plane.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATION
(1) This application is a national stage of International Application No. PCT/CN2020/083697, filed on Apr. 8, 2020, and entitled "OPTICAL SYSTEM, IMAGE CAPTURING MODULE, AND ELECTRONIC DEVICE", the content of which is incorporated herein in entirety by reference.
TECHNICAL FIELD
(2) The present disclosure relates to the field of photographing, and more particularly, to an optical system, an image capturing module, and an electronic device.
BACKGROUND
(3) With the continuous development of electronic devices such as smart phones and tablet computers, photographing functions have become indispensable functions in the electronic devices. The volume of the electronic devices tends to become more and more miniaturized, which also puts forward higher requirements for the size of the optical system in the electronic devices. However, the head of the current camera lens is usually large, and it is difficult to meet the requirements of the miniaturization design of the electronic devices.
SUMMARY
(4) According to various embodiments of the present disclosure, an optical imaging system, an image capturing module, and an electronic device are provided.
(5) An optical system, sequentially arranged from an object side to an image side, includes: a first lens having a positive refractive power; a second lens having a refractive power; a third lens having a negative refractive power, an object side surface and an image side surface of the third lens being both concave at their circumferences; a fourth lens having a negative refractive power; a fifth lens having a positive refractive power, at least one of an object side surface and an image side surface of the fifth lens having an inflection point; and a sixth lens having a negative refractive power; the optical system satisfies the following relational expressions:
$0.60 < CT1/SD11 < 1.01$;
$5.5 < TTL/CT1 < 9.0$; where $CT\mathbf{1}$ is a thickness of the first lens on an optical axis, $SD\mathbf{11}$ is half of a maximum effective aperture of an object side surface of the first lens, and TTL is a distance from the object side surface of the first lens to an imaging plane of the optical system on the optical axis.
(6) An image capturing module includes a photosensitive element and the optical system described above, and the photosensitive element is arranged on the image side of the optical system.
(7) An electronic device includes a housing and the image capturing module described above, and the image capturing module is mounted on the housing.
(8) The details of one or more embodiments of the present disclosure are set forth in the accompanying drawings and the description below. Other features, objects and advantages of the present disclosure will become apparent from the description, the accompanying drawings, and the claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) To better describe and illustrate the embodiments and/or examples of the disclosure disclosed herein, reference may be made to one or more accompanying drawings. The additional details or examples used to describe the accompanying drawings are not to be construed as limiting the scope of any one of the disclosed disclosure, the presently described embodiments and/or examples, and the presently understood preferred mode of the disclosure.
(2) FIG. **1** is a schematic view of an optical system in a first embodiment of the present disclosure.

(3) FIG. **2** is graphs of spherical aberration, astigmatism, and distortion of the optical system in the first embodiment of the present disclosure.

(4) FIG. **3** is a schematic view of an optical system in a second embodiment of the present disclosure.

(5) FIG. **4** is graphs of spherical aberration, astigmatism, and distortion of the optical system in the second embodiment of the present disclosure.

(6) FIG. **5** is a schematic view of an optical system in a third embodiment of the present disclosure.

(7) FIG. **6** is graphs of spherical aberration, astigmatism, and distortion of the optical system in the third embodiment of the present disclosure.

(8) FIG. **7** is a schematic view of an optical system in a fourth embodiment of the present disclosure.

(9) FIG. **8** is graphs of spherical aberration, astigmatism, and distortion of the optical system in the fourth embodiment of the present disclosure.

(10) FIG. **9** is a schematic view of an optical system in a fifth embodiment of the present disclosure.

(11) FIG. **10** is graphs of spherical aberration, astigmatism, and distortion of the optical system in the fifth embodiment of the present disclosure.

(12) FIG. **11** is a schematic view of an optical system in a sixth embodiment of the present disclosure.

(13) FIG. **12** is graphs of spherical aberration, astigmatism, and distortion of the optical system in the sixth embodiment of the present disclosure.

(14) FIG. **13** is a schematic view of an image capturing module in an embodiment of the present disclosure.

(15) FIG. **14** is a schematic view of an electronic device in an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

(16) In order to facilitate the understanding of the present disclosure, the present disclosure will be described more fully hereinafter with reference to the related accompanying drawings. Preferable embodiments of the present disclosure are presented in the accompanying drawings. However, the present disclosure may be embodied in many different forms and is not limited to the embodiments described herein. Rather, the purpose of providing these embodiments is to make the content of the present disclosure more thorough and comprehensive.

(17) It should be noted that when an element is referred to as being "fixed to" another element, it can be directly fixed to another element or indirectly connected to another element with a mediating element. When an element is considered to be "connected to" another element, it can be directly connected to another element or indirectly connected to another element with a mediating element. The terms "in", "outer", "left", "right", and the like used herein are for illustrative purposes only and are not intended to be the only embodiments.

(18) Referring to FIG. **1**, in some embodiments of the present disclosure, an optical system **100** includes, sequentially arranged from an object side to an image side, a first lens L**1**, a second lens L**2**, a third lens L**3**, a fourth lens L**4**, a fifth lens L**5**, and a sixth lens L**6**. Specifically, the first lens L**1** includes an object side surface S**1** and an image side surface S**2**, the second lens L**2** includes an object side surface S**3** and an image side surface S**4**, the third lens L**3** includes an object side surface S**5** and an image side surface S**6**, the fourth lens L**4** includes an object side surface S**7** and an image side surface S**8**, the fifth lens L**5** includes an object side surface S**9** and an image side surface S**10**, and the sixth lens L**6** includes an object side surface S**11** and an image side surface S**12**.

(19) The first lens L**1** has a positive refractive power, and the second lens L**2** has a refractive power. The third lens L**3** has a negative refractive power, and the object side surface S**5** and the image side surface S**6** of the third lens L**3** are both concave at their circumferences. The fourth lens

L**4** has a negative refractive power. The fifth lens L**5** has a positive refractive power, and at least one of the object side surface S**9** and the image side surface S**10** of the fifth lens L**5** has an inflection point to correct the aberration of the off-axis field of view and improve the imaging quality of the optical system **100**. The lenses of the optical system **100** are arranged coaxially, and central axes of the lenses are on the same straight line, this straight line is an optical axis of the optical system **100**.

(20) In addition, in some embodiments, the optical system **100** is provided with an optical stop STO, and the optical stop STO may be arranged on an object side of the first lens L**1**. In some embodiments, the optical system **100** further includes an infrared filter L**7** arranged on an image side of the sixth lens L**6**, and the infrared filter L**7** includes an object side surface S**13** and an image side surface S**14**. Further, the optical system **100** further includes an image plane S**15** located on the image side of the sixth lens L**6**. Incident light can be imaged on the image plane S**15** after being adjusted by the first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6**. It is worth noting that the infrared filter L**7** may be an infrared cut-off filter, which is configured to filter out interference light and prevent the interference light from reaching the image plane S**15** of the optical system **100** and affecting normal imaging.

(21) In some embodiments, the object side surfaces and the image side surfaces of the lenses of the optical system **100** are all aspherical surfaces. The use of the aspherical structure can improve the flexibility of the lens design, effectively correct spherical aberration, and improve imaging quality. In some other embodiments, the object side surface S**9** and the image side surface S**10** of the fifth lens L**5** are both aspherical surfaces, while the object side surfaces and the image side surfaces of the remaining lenses of the optical system **100** may be all spherical surfaces. It should be noted that the aforementioned embodiments are merely examples of some embodiments of the present disclosure. In some embodiments, the surfaces of the remaining lenses in the optical system **100** may be any combination of aspherical surfaces or spherical surfaces.

(22) In some embodiments, the lenses in the optical system **100** may be all made of glass or plastic. The use of plastic lenses can reduce the weight of the optical system **100** and reduce the production cost, which, in addition with the smaller size of the optical system, can achieve a light and miniaturization design of the optical system. The use of glass lenses enables the optical system **100** to have excellent optical performance and higher temperature resistance. It should be noted that the lenses in the optical system **100** can also be made of materials of any combination of glass and plastic, and not necessarily be all made of glass or plastic.

(23) It should be noted that the first lens L**1** does not mean that there is only one lens. In some embodiments, there may also be two or more lenses in the first lens L**1**, and the two or more lenses can form a cemented lens. A surface of the cemented lens closest to the object side can be regarded as the object side surface S**1**, and a surface of the cemented lens closest to the image side can be regarded as the image side surface S**2**. Alternatively, the lenses of the first lens L**1** do not form a cemented lens, but the distances between the lenses are relatively fixed. In this case, an object side surface of the lens closest to the object side is the object side surface S**1**, and an image side surface of the lens closest to the image side is the image side surface S**2**. In addition, in some embodiments, the number of lenses in the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, or the sixth lens L**6** can also be greater than or equal to two, and any adjacent lenses can form a cemented lens or can be a non-cemented lens.

(24) Further, in some embodiments, the optical system **100** satisfies a relational expression: $0.60 < CT\textbf{1}/SD\textbf{11} < 1.01$; where CT**1** is a thickness of the first lens L**1** on the optical axis, that is, a center thickness of the first lens L**1**, and SD**11** is half of a maximum effective aperture of the object side surface S**1** of the first lens L**1**. Specifically, CT**1**/SD**11** may be 0.64, 0.69, 0.73, 0.75, 0.82, 0.86, 0.89, 0.91, 0.93, or 0.98. When the above relational expression is satisfied, the first lens L**1** can be reasonably configured, so that the head of the camera lens is smaller, thereby satisfying the requirements of the miniaturization design of the electronic device.

(25) In some embodiments, the optical system **100** satisfies a relational expression: $5.5<TTL/CT1<9.0$; where CT**1** is the thickness of the first lens L**1** on the optical axis, and TTL is a distance from the object side surface S**1** of the first lens L**1** to the image plane S**15** on the optical axis. Specifically, TTL/CT**1** may be 5.81, 5.92, 6.31, 6.58, 6.85, 6.92, 7.12, 7.34, 7.58, or 7.69. When the above relational expression is satisfied, the first lens L**1** and a total system length of the optical system **100** can be reasonably configured, the total system length of the optical system **100** can be made smaller while ensuring that the head of the camera lens is small, which further satisfies the requirements of the miniaturization design of the electronic devices. In addition, it can also be ensured that the first lens L**1** has a sufficient thickness, so that the yield rate of the first lens L**1** during processing and molding is higher, and thus the yield rate of the assembly of the optical system **100** is further improved.

(26) In some embodiments, the optical system **100** satisfies a relational expression: $2.2\leq FNO\leq 2.6$; where FNO is an f-number of the optical system **100**. Specifically, the FNO may be 2.30, 2.32, 2.36, 2.39, 2.41, 2.47, 2.48, 2.51, 2.53, or 2.55. When the above relational expression is satisfied, while ensuring that the optical system **100** has a sufficient amount of light flux, it is also beneficial to make the head of the camera lens smaller.

(27) In some embodiments, the optical system **100** satisfies a relational expression: $1<|f3/f4|<10$; where f3 is an effective focal length of the third lens L**3**, and f4 is an effective focal length of the fourth lens L**4**. Specifically, $|f3/f4|$ may be 1.336, 1.735, 2.208, 2.896, 3.528, 3.619, 4.626, 5.462, 7.264, or 9.218. When the above relational expression is satisfied, the third lens L**3** and the fourth lens L**4** can be reasonably configured, so as to effectively expand the field of view of the optical system **100**, thereby reducing the total system length of the optical system **100**, and satisfying the requirements of the miniaturization design.

(28) In some embodiments, the optical system **100** satisfies a relational expression: $2.0<|f4/f1|+|f5/f6|<4.0$; where f1 is an effective focal length of the first lens L**1**, f4 is the effective focal length of the fourth lens L**4**, f5 is an effective focal length of the fifth lens L**5**, and f6 is an effective focal length of the sixth lens L**6**. Specifically, $|f4/f1|+|f5/f6|$ may be 3.11, 3.16, 3.19, 3.22, 3.27, 3.41, 3.45, 3.49, 3.53, or 3.58. When the above relational expression is satisfied, the refractive powers of the first lens L**1**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** can be reasonably configured, so as to ensure that the positive and negative spherical aberrations of the optical system **100** can be balanced with each other, thereby improving the imaging quality of the optical system **100**.

(29) In some embodiments, the optical system **100** satisfies a relational expression: $1.0<f/f12<1.5$; where f is a total effective focal length of the optical system **100**, and f12 is a combined focal length of the first lens L**1** and the second lens L**2**. Specifically, f/f12 may be 1.05, 1.06, 1.07, 1.09, 1.10, 1.12, 1.15, 1.16, 1.17, or 1.18. When the above relational expression is satisfied, the effective focal length of the optical system **100** and the combined focal length of the first lens L**1** and the second lens L**2** can be reasonably configured, so as to effectively shorten the total system length of the optical system **100** and avoid the excessive increase of high-order spherical aberration of the optical system **100**, thereby improving the imaging quality of the optical system **100**.

(30) In some embodiments, the optical system **100** satisfies a relational expression: $TT/ImgH<1.1$; where TT is a distance from the object side surface S**1** of the first lens L**1** to the image side surface S**12** of the sixth lens L**6** on the optical axis, and ImgH is half of a diagonal length of an effective pixel area of the optical system **100** on an imaging plane. Specifically, TT/ImgH may be 1.05, 1.06, 1.07, or 1.08. When the above relational expression is satisfied, the imaging quality of the optical system **100** on the image plane S**15** can be improved, and the total system length of the optical system **100** can be effectively shortened, which further satisfies the requirements of the miniaturization design of the lens.

(31) In some embodiments, the optical system **100** satisfies a relational expression: $-1.5<R9/R10<0$; where R**9** is a radius of curvature of the object side surface S**9** of the fifth lens L**5**

at the optical axis, and R**10** is a radius of curvature of the image side surface S**10** of the fifth lens L**5** at the optical axis. Specifically, R**9**/R**10** may be −1.19, −1.15, −1.11, −1.09, −0.98, −0.92, −0.88, −0.82, −0.75, or −0.72. When the above relational expression is satisfied, the relation between the object side surface S**9** and the image side surface S**10** of the fifth lens L**5** can be reasonably restricted, so that the deflection angle of the optical system **100** can be reasonably distributed, and the astigmatism of the off-axis field of view of the optical system **100** can be improved, thereby improving the imaging quality of the optical system **100**.

(32) In some embodiments, the optical system **100** satisfies a relational expression: $1<|f6|/R\mathbf{12}<2$; where f6 is the effective focal length of the sixth lens L**6**, and R**12** is a radius of curvature of the image side surface S**12** of the sixth lens L**6** at the optical axis. Specifically, |f6|/R**12** may be 1.82, 1.84, 1.85, 1.88, 1.89, 1.90, 1.92, 1.96, 1.97, or 1.98. When the above relational expression is satisfied, the effective focal length of the sixth lens L**6** and the image side surface S**12** can be reasonably configured, so as to reduce the incident angle of light rays reaching the image plane S**15** of the optical system **100**, so that the optical system **100** can be more easily matched with a photosensitive element.

(33) In some embodiments, the optical system **100** satisfies a relational expression: $1.0<CT\mathbf{5}/|SAG\mathbf{51}|<5.0$; where CT**5** is a thickness of the fifth lens L**5** on the optical axis, and SAG**51** is a sagittal height of the object side surface S**9** of the fifth lens L**5**, that is, a distance in a direction parallel to the optical axis from an intersection of the object side surface S**9** of the fifth lens L**5** on the optical axis to a maximum effective radius position of the object side surface S**9** of the fifth lens L**5**. Specifically, CT**5**/|SAG**51**| may be 1.91, 2.13, 2.52, 2.68, 3.22, 3.34, 3.87, 3.92, 4.13, or 4.26. When the above relational expression is satisfied, the fifth lens L**5** can be reasonably configured, so that the surface shape of the fifth lens L**5** can be more reasonable, so as to reduce the defect rate of the fifth lens L**5** during the processing and molding. In addition, the aberrations generated in the optical system **100** can be corrected, thereby further improving the imaging quality of the optical system **100**.

(34) According to the aforementioned descriptions of the various embodiments, more specific embodiments and accompanying drawings are provided below for detailed description.

First Embodiment

(35) Referring to FIGS. **1** and **2**, FIG. **1** is a schematic view of an optical system **100** in the first embodiment. The optical system **100** includes, sequentially arranged from an object side to an image side, an optical stop STO, a first lens L**1** having a positive refractive power, a second lens L**2** having a negative refractive power, a third lens L**3** having a negative refractive power, a fourth lens L**4** having a negative refractive power, a fifth lens L**5** having a positive refractive power, and a sixth lens L**6** having a negative refractive power. FIG. **2** is, sequentially from left to right, graphs of spherical aberration, astigmatism, and distortion of the optical system **100** in the first embodiment, where the graphs of astigmatism and distortion are both graphs at 555 nm, which are the same in other embodiments.

(36) An object side surface S**1** of the first lens L**1** is convex at its paraxial position and convex at its circumference.

(37) An image side surface S**2** of the first lens L**1** is planar at its paraxial position and planar at its circumference.

(38) An object side surface S**3** of the second lens L**2** is planar at its paraxial position and planar at its circumference.

(39) An image side surface S**4** of the second lens L**2** is concave at its paraxial position and convex at its circumference.

(40) An object side surface S**5** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(41) An image side surface S**6** of the third lens L**3** is convex at its paraxial position and concave at its circumference.

(42) An object side surface S**7** of the fourth lens L**4** is concave at its paraxial position and concave at its circumference.

(43) An image side surface S**8** of the fourth lens L**4** is concave at its paraxial position and convex at its circumference.

(44) An object side surface S**9** of the fifth lens L**5** is convex at its paraxial position and concave at its circumference.

(45) An image side surface S**10** of the fifth lens L**5** is convex at its paraxial position and convex at its circumference.

(46) An object side surface S**11** of the sixth lens L**6** is convex at its paraxial position and convex at its circumference.

(47) An image side surface S**12** of the sixth lens L**6** is concave at its paraxial position and concave at its circumference.

(48) The image side surface S**2** of the first lens L**1** and the object side surface S**3** of the second lens L**2** are planar, while the object side surface S**1** of the first lens L**1**, the image side surface S**4** of the second lens L**2**, and the object side surfaces and the image side surfaces of the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all aspherical.

(49) It should be noted that, in the present disclosure, when describing that a surface of a lens is convex at its paraxial position (a central area of this side surface), it can be understood as that an area of this surface of the lens near the optical axis is convex. When describing that a surface of a lens is concave at its circumference, it can be understood as that an area of this surface near the maximum effective radius is concave. For example, when this surface is convex at the optical axis and is also convex at its circumference, a shape of this surface in a direction from the center (the optical axis) to the edge may be completely convex, or the surface may be firstly transited from a convex shape at the center to a concave shape, and then become a convex surface at a position close to its maximum effective radius. These are only examples to illustrate the relation between the positions of the optical axis and the circumference. The various shapes and structures (concave-convex relationship) of the surface are not fully described, but other situations can be derived from the above examples.

(50) The first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all made of plastic.

(51) Further, the optical system **100** satisfies a relational expression: CT**1**/SD**11**=1.001; where CT**1** is a thickness of the first lens L**1** on the optical axis, that is, a center thickness of the first lens L**1**, and SD**11** is half of a maximum effective aperture of the object side surface S**1** of the first lens L**1**. When the above relational expression is satisfied, the first lens L**1** can be reasonably configured, so that the head of the camera lens is smaller, thereby satisfying the requirements of the miniaturization design of the electronic device.

(52) The optical system **100** satisfies a relational expression: TTL/CT**1**=5.80; where CT**1** is the thickness of the first lens L**1** on the optical axis, and TTL is a distance from the object side surface S**1** of the first lens L**1** to the image plane S**15**. When the above relational expression is satisfied, the first lens L**1** and a total system length of the optical system **100** can be reasonably configured, the total system length of the optical system **100** can be made smaller while ensuring that the head of the camera lens is small, which further satisfies the requirements of the miniaturization design of the electronic devices. In addition, it can also be ensured that the first lens L**1** has a sufficient thickness, so that the yield rate of the first lens L**1** during processing and molding is higher, and thus the yield rate of the assembly of the optical system **100** is further improved.

(53) The optical system **100** satisfies a relational expression: FNO=2.54; where FNO is an f-number of the optical system **100**. When the above relational expression is satisfied, while ensuring that the optical system **100** has a sufficient amount of light flux, it is also beneficial to make the head of the camera lens smaller.

(54) The optical system **100** satisfies a relational expression: |f3/f4|=9.218; where f3 is an effective

focal length of the third lens L3, and f4 is an effective focal length of the fourth lens L4. When the above relational expression is satisfied, the third lens L3 and the fourth lens L4 can be reasonably configured, so as to effectively expand the field of view of the optical system 100, thereby reducing the total system length of the optical system 100, and satisfying the requirements of the miniaturization design.

(55) The optical system 100 satisfies a relational expression: $|f4/f1|+|f5/f6|=3.58$; where f1 is an effective focal length of the first lens L1, f4 is the effective focal length of the fourth lens L4, f5 is an effective focal length of the fifth lens L5, and f6 is an effective focal length of the sixth lens L6. When the above relational expression is satisfied, the refractive powers of the first lens L1, the fourth lens L4, the fifth lens L5, and the sixth lens L6 can be reasonably configured, so as to ensure that the positive and negative spherical aberrations of the optical system 100 can be balanced with each other, thereby improving the imaging quality of the optical system 100.

(56) The optical system 100 satisfies a relational expression: $f/f12=1.05$; where f is a total effective focal length of the optical system 100, and f12 is a combined focal length of the first lens L1 and the second lens L2. When the above relational expression is satisfied, the effective focal length of the optical system 100 and the combined focal length of the first lens L1 and the second lens L2 can be reasonably configured, so as to effectively shorten the total system length of the optical system 100 and avoid the excessive increase of high-order spherical aberration of the optical system 100, thereby improving the imaging quality of the optical system 100.

(57) The optical system 100 satisfies a relational expression: $TT/ImgH=1.05$; where TT is a distance from the object side surface S1 of the first lens L1 to the image side surface S12 of the sixth lens L6 on the optical axis, and ImgH is half of a diagonal length of an effective pixel area of the optical system 100 on the imaging plane. When the above relational expression is satisfied, the imaging quality of the optical system 100 on the image plane S15 can be improved, and the total system length of the optical system 100 can be effectively shortened, which further satisfies the requirements of the miniaturization design of the lens.

(58) The optical system 100 satisfies a relational expression: $R9/R10=-1.19$; where R9 is a radius of curvature of the object side surface S9 of the fifth lens L5 at the optical axis, and R10 is a radius of curvature of the image side surface S10 of the fifth lens L5 at the optical axis. When the above relational expression is satisfied, the relation between the object side surface S9 and the image side surface S10 of the fifth lens L5 can be reasonably restricted, so that the deflection angle of the optical system 100 can be reasonably distributed, and the astigmatism of the off-axis field of view of the optical system 100 can be improved, thereby improving the imaging quality of the optical system 100.

(59) The optical system 100 satisfies a relational expression: $|f6|/R12=1.83$; where f6 is the effective focal length of the sixth lens L6, and R12 is a radius of curvature of the image side surface S12 of the sixth lens L6 at the optical axis. When the above relational expression is satisfied, the effective focal length of the sixth lens L6 and the image side surface S12 can be reasonably configured, so as to reduce the incident angle of light rays reaching the image plane S15 of the optical system 100, so that the optical system 100 can be more easily matched with a photosensitive element.

(60) The optical system 100 satisfies a relational expression: $CT5/|SAG51|=3.70$; where CT5 is a thickness of the fifth lens L5 on the optical axis, and SAG51 is a sagittal height of the object side surface S9 of the fifth lens L5. When the above relational expression is satisfied, the fifth lens L5 can be reasonably configured, so that the surface shape of the fifth lens L5 can be more reasonable, so as to reduce the defect rate of the fifth lens L5 during the processing and molding. In addition, the aberrations generated in the optical system 100 can be corrected, thereby further improving the imaging quality of the optical system 100.

(61) In addition, various parameters of the optical system 100 are given in Table 1. The image plane S15 in Table 1 can be understood as an imaging plane of the optical system 100. The

elements from an object plane (not shown in the figures) to the image plane S**15** are sequentially arranged in the order of the elements from top to bottom in Table 1. The Y radius in Table 1 is a radius of curvature of an object side surface or an image side surface with a corresponding surface number on the optical axis. The surface numbers **1** and **2** are the object side surface S**1** and the image side surface S**2** of the first lens L**1**, respectively. That is, in the same lens, a surface with a smaller surface number is an object side surface, and a surface with a larger surface number is an image side surface. The first value in the "thickness" parameter column of the first lens L**1** is a thickness of the lens on the optical axis, and the second value therein is a distance on the optical axis from the image side surface of the lens to an object side surface of a rear lens in a direction towards the image side.

(62) It should be noted that in this embodiment and the following various embodiments, the optical system **100** may not be provided with the infrared filter L**7**, but in this case, a distance from the image side surface S**11** of the sixth lens L**6** to the image plane S**15** remains unchanged.

(63) In the first embodiment, the total effective focal length of the optical system **100** is indicated by f, and f=3.68 mm. The f-number thereof is indicated by FNO, and FNO=2.54. The half of the maximum field of view is indicated by HFOV, and HFOV=41.06°. The distance from the object side surface S**1** of the first lens L**1** to the image plane S**15** on the optical axis is indicated by TTL, and TTL=4.4 mm.

(64) In addition, the focal length, refractive index, and Abbe number of each of the lenses are values at a wavelength of 555 nm, and the same applies to other embodiments.

(65) TABLE-US-00001 TABLE 1 First Embodiment f = 3.68 mm, FNO = 2.54, HFOV = 41.06°, TTL = 4.4 mm Surface Surface Surface Y radius Thickness Refractive Abbe Focal length number name shape (mm) (mm) Material index number (mm) Object plane Spherical Infinite 394 Optical stop Spherical Infinite −0.129 1 First lens Aspherical 1.613 0.759 Plastic 1.546 56.14 2.95 2 Aspherical Infinite 0.050 3 Second lens Aspherical Infinite 0.250 Plastic 1.546 56.14 −14.50 4 Aspherical 7.915 0.093 5 Third lens Aspherical −20.750 0.280 Plastic 1.666 20.37 −64.25 6 Aspherical −40.475 0.238 7 Fourth lens Aspherical −79.355 0.290 Plastic 1.645 23.54 −6.97 8 Aspherical 4.767 0.192 9 Fifth lens Aspherical 3.200 0.666 Plastic 1.546 56.14 2.79 10 Aspherical −2.685 0.328 11 Sixth lens Aspherical 563.270 0.326 Plastic 1.546 56.14 −2.29 12 Aspherical 1.249 0.310 13 Infrared filter Spherical Infinite 0.210 Glass 1.518 64.17 14 Spherical Infinite 0.408 15 Image plane Spherical Infinite 0.000

(66) Further, the aspheric coefficients of the image side surfaces or the object side surfaces of the lenses of the optical system **100** are given in Table 2. The surface numbers from 1-10 represent the image side surfaces or the object side surfaces S**1**-S**10**, respectively. The K to A**20** from top to bottom represent the types of the aspheric coefficients, respectively, where K represents a conic coefficient, A**4** represents a fourth-order aspheric coefficient, A**6** represents a sixth-order aspheric coefficient, and A**8** is an eighth-order aspheric coefficient, and so on. In addition, the aspheric coefficient equation is as follows:

(67) $Z = \dfrac{cr^2}{1+\sqrt{1-(k+1)c^2r^2}} + \sum_i \mathrm{A}i\ r^i$

(68) where, Z is a distance from a corresponding point on the aspherical surface to a plane tangent to a vertex of the surface, r is a distance from a corresponding point on the aspherical surface to the optical axis, c is a curvature of the vertex of the aspherical surface, k is a conic coefficient, and Ai is a coefficient corresponding to a high-order term of the i.sup.th term in the equation of the aspherical surface shape.

(69) TABLE-US-00002 TABLE 2 First Embodiment Aspheric coefficient Surface number 1 2 3 4 5 6 K −4.6198E+00 1.0000E+00 1.0000E+00 −5.0000E+01 3.0000E+01 −5.0000E+01 A4 1.1936E−01 3.6869E−02 3.2258E−02 −1.1334E−01 −4.2808E−02 1.0970E−01 A6 −3.0613E−03 −5.1250E−01 −1.9135E−01 −1.4635E−01 −4.1251E−01 −2.6859E−01 A8 −5.0869E−01 4.5843E+00 8.1092E−02 −2.1782E+00 −3.6638E−01 6.1508E−01 A10 2.2954E+00

−2.4375E+01 8.2420E+00 1.5945E+01 7.6378E+00 −4.5595E−01 A12 −5.3919E+00
7.5584E+01 −6.1183E+01 −5.7803E+01 −2.9619E+01 1.7876E−01 A14 6.5558E+00
−1.4024E+02 1.9924E+02 1.1705E+02 6.1589E+01 −4.2137E−02 A16 −3.2594E+00
1.5505E+02 −3.3615E+02 −1.2117E+02 −6.4964E+01 0.0000E+00 A18 0.0000E+00
−9.4868E+01 2.8764E+02 4.9545E+01 2.6770E+01 0.0000E+00 A20 0.0000E+00
2.4857E+01 −9.8988E+01   0.0000E+00 0.0000E+00 0.0000E+00 Surface number 7 8 9 10 11
12 K 5.0000E+01 −1.9990E+01 −1.1302E+01 −3.7576E+01 −1.5017E+01 −7.9842E+00 A4
−1.2951E−01 −2.4089E−01 −6.4338E−03 1.1234E−02 −3.9618E−01 −2.2194E−01 A6
4.8684E−01 2.6803E−01 −2.3170E−01 −4.2480E−02 2.1950E−01 1.7054E−01 A8
−2.2834E+00 −2.7059E−01 5.2030E−01 4.7069E−02 −3.3018E−02 −9.9184E−02 A10
7.8221E+00 2.4577E−01 −7.4016E−01 −9.0827E−03 −7.2916E−03 4.2828E−02 A12
−1.7576E+01 −7.8124E−02 6.7761E−01 −1.5733E−02 2.5762E−03 −1.3315E−02 A14
2.5309E+01 −1.2314E−01 −3.9778E−01 1.1829E−02 8.0434E−05 2.7878E−03 A16
−2.2717E+01 1.4792E−01 1.4105E−01 −3.5652E−03 −1.2311E−04 −3.6474E−04 A18
1.1575E+01 −6.2327E−02 −2.6970E−02 5.0866E−04 1.8116E−05 2.6738E−05 A20
−2.5654E+00 9.5591E−03 2.1132E−03 −2.8226E−05 −8.7338E−07 −8.3712E−07

Second Embodiment

(70) Referring to FIGS. **3** and **4**, FIG. **3** is a schematic view of an optical system **100** in the second embodiment. The optical system **100** includes, sequentially arranged from an object side to an image side, an optical stop STO, a first lens L**1** having a positive refractive power, a second lens L**2** having a negative refractive power, a third lens L**3** having a negative refractive power, a fourth lens L**4** having a negative refractive power, a fifth lens L**5** having a positive refractive power, and a sixth lens L**6** having a negative refractive power. FIG. **4** is, sequentially from left to right, graphs of spherical aberration, astigmatism, and distortion of the optical system **100** in the second embodiment.

(71) An object side surface S**1** of the first lens L**1** is convex at its paraxial position and convex at its circumference.

(72) An image side surface S**2** of the first lens L**1** is planar at its paraxial position and planar at its circumference.

(73) An object side surface S**3** of the second lens L**2** is planar at its paraxial position and planar at its circumference.

(74) An image side surface S**4** of the second lens L**2** is concave at its paraxial position and convex at its circumference.

(75) An object side surface S**5** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(76) An image side surface S**6** of the third lens L**3** is convex at its paraxial position and concave at its circumference.

(77) An object side surface S**7** of the fourth lens L**4** is concave at its paraxial position and concave at its circumference.

(78) An image side surface S**8** of the fourth lens L**4** is concave at its paraxial position and convex at its circumference.

(79) An object side surface S**9** of the fifth lens L**5** is convex at its paraxial position and concave at its circumference.

(80) An image side surface S**10** of the fifth lens L**5** is convex at its paraxial position and convex at its circumference.

(81) An object side surface S**11** of the sixth lens L**6** is convex at its paraxial position and convex at its circumference.

(82) An image side surface S**12** of the sixth lens L**6** is concave at its paraxial position and concave at its circumference.

(83) The image side surface S**2** of the first lens L**1** and the object side surface S**3** of the second lens

L2 are planar, while the object side surface S1 of the first lens L1, the image side surface S4 of the second lens L2, and the object side surfaces and the image side surfaces of the third lens L3, the fourth lens L4, the fifth lens L5, and the sixth lens L6 are all aspherical.

(84) The first lens L1, the second lens L2, the third lens L3, the fourth lens L4, the fifth lens L5, and the sixth lens L6 are all made of plastic.

(85) In addition, various parameters of the optical system 100 are given in Table 3, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(86) TABLE-US-00003 TABLE 3 Second embodiment f = 3.67 mm, FNO = 2.55, HFOV = 41.13°, TTL = 4.4 mm Surface Surface Surface Y radius Thickness Refractive Abbe Focal length number name shape (mm) (mm) Material index number (mm) Object plane Spherical Infinite 394 Optical stop Spherical Infinite −0.130 1 First lens Aspherical 1.616 0.730 Plastic 1.546 56.14 2.96 2 Aspherical Infinite 0.050 3 Second lens Aspherical Infinite 0.258 Plastic 1.546 56.14 −15.78 4 Aspherical 8.616 0.097 5 Third lens Aspherical −19.615 0.277 Plastic 1.666 20.37 −45.80 6 Aspherical −55.183 0.235 7 Fourth lens Aspherical −70.507 0.298 Plastic 1.645 23.54 −7.01 8 Aspherical 4.829 0.200 9 Fifth lens Aspherical 3.134 0.669 Plastic 1.546 56.14 2.78 10 Aspherical −2.727 0.330 11 Sixth lens Aspherical −386.669 0.329 Plastic 1.546 56.14 −2.31 12 Aspherical 1.267 0.309 13 Infrared filter Spherical Infinite 0.210 Glass 1.518 64.17 14 Spherical Infinite 0.408 15 Image plane Spherical Infinite 0.000

(87) Further, the aspheric coefficients of the image side surfaces or the object side surfaces of the lenses of the optical system 100 are given in Table 4, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(88) TABLE-US-00004 TABLE 4 Second embodiment Aspheric coefficient Surface number 1 2 3 4 5 6 K −4.6557E+00 1.0000E+00 1.0000E+00 −5.0000E+01 3.0000E+01 −4.9699E+01 A4 1.2012E−01 3.8097E−02 3.9654E−02 −1.1368E−01 −4.3566E−02 1.1775E−01 A6 −2.6116E−02 −5.6242E−01 −2.8926E−01 −1.6104E−01 −3.8656E−01 −3.1703E−01 A8 −3.2888E−01 4.8517E+00 6.9985E−01 −2.2456E+00 −7.8303E−01 7.5239E−01 A10 1.5175E+00 −2.4286E+01 6.6102E+00 1.7124E+01 1.0082E+01 −6.7550E−01 A12 −3.6040E+00 7.0582E+01 −5.9958E+01 −6.2229E+01 −3.6572E+01 3.6620E−01 A14 4.4609E+00 −1.2292E+02 2.0067E+02 1.2415E+02 7.1858E+01 −1.0665E−01 A16 −2.2763E+00 1.2797E+02 −3.3772E+02 −1.2619E+02 −7.2476E+01 0.0000E+00 A18 0.0000E+00 −7.4022E+01 2.8608E+02 5.0733E+01 2.8899E+01 0.0000E+00 A20 0.0000E+00 1.8398E+01 −9.7289E+01 0.0000E+00 0.0000E+00 0.0000E+00 Surface number 7 8 9 10 11 12 K 4.4680E+01 −2.3977E+01 −1.1446E+01 −3.6906E+01 5.0000E+01 −7.8769E+00 A4 −1.2432E−01 −2.3698E−01 −7.0824E−03 1.2871E−02 −3.9234E−01 −2.2200E−01 A6 4.4185E−01 2.4676E−01 −2.2265E−01 −4.3614E−02 2.2629E−01 1.7336E−01 A8 −2.1163E+00 −2.0733E−01 4.9204E−01 4.0326E−02 −4.9531E−02 −1.0215E−01 A10 7.4087E+00 1.2121E−01 −6.8969E−01 3.3138E−03 5.6263E−03 4.4453E−02 A12 −1.6945E+01 7.1279E−02 6.2461E−01 −2.5388E−02 −2.7552E−03 −1.3886E−02 A14 2.4792E+01 −2.3127E−01 −3.6449E−01 1.5974E−02 1.3729E−03 2.9207E−03 A16 −2.2593E+01 1.9471E−01 1.2892E−01 −4.5889E−03 −3.0871E−04 −3.8438E−04 A18 1.1682E+01 −7.3586E−02 −2.4642E−02 6.4549E−04 3.2790E−05 2.8371E−05

(89) In addition, according to the parameter information provided above, the following relations can be derived:

$CT1/SD11=0.967$; $TTL/CT1=6.03$; $FNO=2.55$; $|f3/f4|=6.534$;

$|f4/f1|+|f5/f6|=3.57$; $f/f12=1.06$; $TT/ImgH=1.05$; $R9/R10=−1.15$;

$|f6|/R12=1.82$; $CT5/|SAG51|=3.78$.

Third Embodiment

(90) Referring to FIGS. 5 and 6, FIG. 5 is a schematic view of an optical system 100 in the third embodiment. The optical system 100 includes, sequentially arranged from an object side to an

image side, an optical stop STO, a first lens L**1** having a positive refractive power, a second lens L**2** having a negative refractive power, a third lens L**3** having a negative refractive power, a fourth lens L**4** having a negative refractive power, a fifth lens L**5** having a positive refractive power, and a sixth lens L**6** having a negative refractive power. FIG. **6** is, sequentially from left to right, graphs of spherical aberration, astigmatism, and distortion of the optical system **100** in the third embodiment.
(91) An object side surface S**1** of the first lens L**1** is convex at its paraxial position and convex at its circumference.
(92) An image side surface S**2** of the first lens L**1** is concave at its paraxial position and concave at its circumference.
(93) An object side surface S**3** of the second lens L**2** is convex at its paraxial position and convex at its circumference.
(94) An image side surface S**4** of the second lens L**2** is concave at its paraxial position and convex at its circumference.
(95) An object side surface S**5** of the third lens L**3** is concave at its paraxial position and concave at its circumference.
(96) An image side surface S**6** of the third lens L**3** is convex at its paraxial position and concave at its circumference.
(97) An object side surface S**7** of the fourth lens L**4** is concave at its paraxial position and concave at its circumference.
(98) An image side surface S**8** of the fourth lens L**4** is concave at its paraxial position and convex at its circumference.
(99) An object side surface S**9** of the fifth lens L**5** is convex at its paraxial position and concave at its circumference.
(100) An image side surface S**10** of the fifth lens L**5** is convex at its paraxial position and convex at its circumference.
(101) An object side surface S**11** of the sixth lens L**6** is convex at its paraxial position and convex at its circumference.
(102) An image side surface S**12** of the sixth lens L**6** is concave at its paraxial position and concave at its circumference.
(103) The object side surfaces and the image side surfaces of the first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all aspherical.
(104) The first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all made of plastic.
(105) In addition, various parameters of the optical system **100** are given in Table 5, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.
(106) TABLE-US-00005 TABLE 5 Third Embodiment f = 3.66 mm, FNO = 2.41, HFOV = 41.21°, TTL = 4.445 mm Surface Surface Surface Y radius Thickness Refractive Abbe Focal length number name shape (mm) (mm) Material index number (mm) Object plane Spherical Infinite 400 Optical stop Spherical Infinite −0.153 1 First lens Aspherical 1.592 0.673 Plastic 1.546 56.14 3.36 2 Aspherical 10.272 0.052 3 Second lens Aspherical 10.888 0.294 Plastic 1.546 56.14 −177.22 4 Aspherical 9.693 0.105 5 Third lens Aspherical −11.954 0.262 Plastic 1.666 20.37 −26.01 6 Aspherical −38.826 0.235 7 Fourth lens Aspherical −71.823 0.335 Plastic 1.645 23.54 −7.05 8 Aspherical 4.854 0.212 9 Fifth lens Aspherical 2.924 0.714 Plastic 1.546 56.14 2.80 10 Aspherical −2.922 0.322 11 Sixth lens Aspherical 112.513 0.332 Plastic 1.546 56.14 −2.43 12 Aspherical 1.307 0.301 13 Infrared Spherical Infinite 0.210 Glass 1.518 64.17 14 filter Spherical Infinite 0.399 15 Image plane Spherical Infinite 0.000
(107) Further, the aspheric coefficients of the image side surfaces or the object side surfaces of the lenses of the optical system **100** are given in Table 6, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(108) TABLE-US-00006 TABLE 6 Third Embodiment Aspheric coefficient Surface number 1 2 3 4 5 6 K −4.4978E+00 −3.4503E+01 −1.7992E+01 −5.0000E+01 2.4038E+01 3.0000E+01 A4 1.2371E−01 3.9205E−02 3.7243E−02 −1.0998E−01 −3.2525E−02 1.1624E−01 A6 −3.2929E−02 −5.0760E−01 −3.4734E−01 −1.6074E−01 −4.4954E−01 −3.1284E−01 A8 −1.6451E−01 3.2833E+00 6.6264E−01 −2.0223E+00 −1.7538E−01 7.1762E−01 A10 6.4984E−01 −1.2062E+01 6.7989E+00 1.4063E+01 5.6424E+00 −6.1903E−01 A12 −1.3752E+00 2.6615E+01 −4.7885E+01 −4.5003E+01 −1.9002E+01 3.0820E−01 A14 1.5923E+00 −3.7705E+01 1.3409E+02 7.9591E+01 3.4661E+01 −8.0246E−02 A16 −7.8640E−01 3.5321E+01 −1.9561E+02 −7.2771E+01 −3.2986E+01 0.0000E+00 A18 0.0000E+00 −2.0334E+01 1.4749E+02 2.6641E+01 1.2447E+01 0.0000E+00 A20 0.0000E+00 5.3735E+00 −4.5559E+01 0.0000E+00 0.0000E+00 0.0000E+00 Surface number 7 8 9 10 11 12 K 5.0000E+01 −3.2271E+01 −1.0343E+01 −3.7734E+01 −4.0000E+01 −7.2234E+00 A4 −1.1661E−01 −2.1245E−01 −8.1680E−03 2.1417E−02 −3.5847E−01 −2.0972E−01 A6 3.5650E−01 1.3812E−01 −2.1740E−01 −6.1260E−02 1.8475E−01 1.5782E−01 A8 −1.7225E+00 1.4935E−01 4.9639E−01 6.1822E−02 −2.1902E−02 −8.9237E−02 A10 6.6102E+00 −5.9366E−01 −6.9442E−01 −1.6543E−02 −8.2219E−03 3.7445E−02 A12 −1.6691E+01 9.1414E−01 6.1770E−01 −1.1820E−02 2.5530E−03 −1.1354E−02 A14 2.6529E+01 −8.3435E−01 −3.5274E−01 1.0028E−02 −3.5306E−05 2.3301E−03 A16 −2.5781E+01 4.5479E−01 1.2244E−01 −3.0550E−03 −7.4560E−05 −3.0019E−04 A18 1.3990E+01 −1.3556E−01 −2.3083E−02 4.3515E−04 1.1111E−05 2.1739E−05 A20 −3.2543E+00 1.6935E−02 1.7951E−03 −2.4154E−05 −5.1714E−07 −6.7383E−07

(109) In addition, according to the parameter information provided above, the following relations can be derived:

$CT1/SD11=0.85$; $TTL/CT1=6.60$; $FNO=2.41$; $|f3/f4|=3.689$;

$|f4/f1|+|f5/f6|=3.25$; $f/f12=1.08$; $TT/ImgH=1.07$; $R9/R10=−1.00$;

$|f6|/R12=1.86$; $CT5/|SAG51|=4.3$.

Fourth Embodiment

(110) Referring to FIGS. **7** and **8**, FIG. **7** is a schematic view of an optical system **100** in the fourth embodiment. The optical system **100** includes, sequentially arranged from an object side to an image side, an optical stop STO, a first lens L**1** having a positive refractive power, a second lens L**2** having a positive refractive power, a third lens L**3** having a negative refractive power, a fourth lens L**4** having a negative refractive power, a fifth lens L**5** having a positive refractive power, and a sixth lens L**6** having a negative refractive power. FIG. **8** is, sequentially from left to right, graphs of spherical aberration, astigmatism, and distortion of the optical system **100** in the fourth embodiment.

(111) An object side surface S**1** of the first lens L**1** is convex at its paraxial position and convex at its circumference.

(112) An image side surface S**2** of the first lens L**1** is concave at its paraxial position and concave at its circumference.

(113) An object side surface S**3** of the second lens L**2** is convex at its paraxial position and convex at its circumference.

(114) An image side surface S**4** of the second lens L**2** is concave at its paraxial position and convex at its circumference.

(115) An object side surface S**5** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(116) An image side surface S**6** of the third lens L**3** is convex at its paraxial position and concave at its circumference.

(117) An object side surface S**7** of the fourth lens L**4** is concave at its paraxial position and concave at its circumference.

(118) An image side surface S**8** of the fourth lens L**4** is concave at its paraxial position and convex at its circumference.

(119) An object side surface S**9** of the fifth lens L**5** is convex at its paraxial position and concave at its circumference.

(120) An image side surface S**10** of the fifth lens L**5** is convex at its paraxial position and convex at its circumference.

(121) An object side surface S**11** of the sixth lens L**6** is convex at its paraxial position and convex at its circumference.

(122) An image side surface S**12** of the sixth lens L**6** is concave at its paraxial position and concave at its circumference.

(123) The object side surfaces and the image side surfaces of the first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all aspherical.

(124) The first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all made of plastic.

(125) In addition, various parameters of the optical system **100** are given in Table 7, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(126) TABLE-US-00007 TABLE 7 Fourth Embodiment f = 3.67 mm, FNO = 2.41, HFOV = 40.15°, TTL = 4.45 mm Surface Surface Surface Y radius Thickness Refractive Abbe Focal length number name shape (mm) (mm) Material index number (mm) Object plane Spherical Infinite 400 Optical stop Spherical Infinite −0.154 1 Aspherical 1.589 0.651 Plastic 1.546 56.14 3.52 2 First lens Aspherical 7.825 0.054 3 Aspherical 7.978 0.312 Plastic 1.546 56.14 76.58 4 Second lens Aspherical 9.723 0.106 5 Aspherical −13.031 0.253 Plastic 1.666 20.37 −22.82 6 Third lens Aspherical −91.639 0.234 7 Aspherical −61.080 0.349 Plastic 1.645 23.54 −7.25 8 Fourth lens Aspherical 5.064 0.216 9 Aspherical 2.933 0.716 Plastic 1.546 56.14 2.81 10 Fifth lens Aspherical −2.934 0.315 11 Aspherical 71.850 0.332 Plastic 1.546 56.14 −2.43 12 Sixth lens Aspherical 1.299 0.303 13 Infrared Spherical Infinite 0.210 Glass 1.518 64.17 14 filter Spherical Infinite 0.401 15 Image plane Spherical Infinite 0.000

(127) Further, the aspheric coefficients of the image side surfaces or the object side surfaces of the lenses of the optical system **100** are given in Table 8, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(128) TABLE-US-00008 TABLE 8 Fourth Embodiment Aspheric coefficient Surface number 1 2 3 4 5 6 K −4.4829E+00 −3.1772E+01 −2.3952E+01 −5.0000E+01 2.1901E+01 4.0000E+01 A4 1.2345E−01 3.4012E−02 2.8057E−02 −1.1154E−01 −2.9557E−02 1.1583E−01 A6 −2.1596E−02 −4.3858E−01 −2.8258E−01 −1.6932E−01 −4.7900E−01 −3.1357E−01 A8 −2.4045E−01 2.8150E+00 5.3736E−01 −1.6231E+00 2.1115E−01 7.3509E−01 A10 9.2635E−01 −1.0613E+01 5.2328E+00 1.1207E+01 3.4655E+00 −6.8920E−01 A12 −1.9213E+00 2.5585E+01 −3.6255E+01 −3.4915E+01 −1.2406E+01 4.0086E−01 A14 2.1358E+00 −4.2612E+01 9.9826E+01 6.0314E+01 2.3237E+01 −1.1957E−01 A16 −9.9782E−01 4.8400E+01 −1.4430E+02 −5.3953E+01 −2.2480E+01 0.0000E+00 A18 0.0000E+00 −3.2715E+01 1.0906E+02 1.9331E+01 8.5121E+00 0.0000E+00 A20 0.0000E+00 9.5845E+00 −3.4161E+01 0.0000E+00 0.0000E+00 0.0000E+00 Surface number 7 8 9 10 11 12 K 5.0000E+01 −3.6362E+01 −1.0568E+01 −3.7709E+01 −4.0000E+01 −6.8352E+00 A4 −1.1353E−01 −2.0852E−01 −1.0588E−02 2.0025E−02 −3.5143E−01 −2.1653E−01 A6 3.1758E−01 1.3322E−01 −2.0968E−01 −6.1092E−02 1.8348E−01 1.7098E−01 A8 −1.4278E+00 1.4459E−01 4.8012E−01 6.6493E−02 −3.0647E−02 −1.0105E−01 A1O 5.3254E+00 −5.6250E−01 −6.6756E−01 −2.3742E−02 9.7688E−04 4.3355E−02 A12 −1.3324E+01 8.4904E−01 5.8798E−01 −6.7859E−03 −1.8451E−03 −1.3143E−02 A14 2.1089E+01 −7.6073E−01 −3.3269E−01 8.1011E−03 1.1502E−03 2.6665E−03 A16 −2.0474E+01 4.0844E−01 1.1458E−01 −2.6385E−03 −2.6050E−04

−3.3869E−04 A18 1.1123E+01 −1.2024E−01 −2.1437E−02 3.8754E−04 2.7000E−05 2.4202E−05 A20 −2.5955E+00 1.4854E−02 1.6531E−03 −2.1919E−05 −1.0909E−06 −7.4134E−07

(129) In addition, according to the parameter information provided above, the following relations can be derived:

$CT1/SD11=0.82$; $TTL/CT1=6.84$; $FNO=2.41$; $|f3/f4|=3.148$;
$|f4/f1|+|f5/f6|=3.21$; $f/f12=1.10$; $TT/ImgH=1.07$; $R9/R10=−1.00$;
$|f6|/R12=1.87$; $CT5/|SAG51|=4.26$.

Fifth Embodiment

(130) Referring to FIGS. **9** and **10**, FIG. **9** is a schematic view of an optical system **100** in the fifth embodiment. The optical system **100** includes, sequentially arranged from an object side to an image side, an optical stop STO, a first lens L**1** having a positive refractive power, a second lens L**2** having a positive refractive power, a third lens L**3** having a negative refractive power, a fourth lens L**4** having a negative refractive power, a fifth lens L**5** having a positive refractive power, and a sixth lens L**6** having a negative refractive power. FIG. **10** is, sequentially from left to right, graphs of spherical aberration, astigmatism, and distortion of the optical system **100** in the fifth embodiment.

(131) An object side surface S**1** of the first lens L**1** is convex at its paraxial position and convex at its circumference.

(132) An image side surface S**2** of the first lens L**1** is concave at its paraxial position and concave at its circumference.

(133) An object side surface S**3** of the second lens L**2** is convex at its paraxial position and convex at its circumference.

(134) An image side surface S**4** of the second lens L**2** is concave at its paraxial position and convex at its circumference.

(135) An object side surface S**5** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(136) An image side surface S**6** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(137) An object side surface S**7** of the fourth lens L**4** is concave at its paraxial position and concave at its circumference.

(138) An image side surface S**8** of the fourth lens L**4** is concave at its paraxial position and convex at its circumference.

(139) An object side surface S**9** of the fifth lens L**5** is convex at its paraxial position and concave at its circumference.

(140) An image side surface S**10** of the fifth lens L**5** is convex at its paraxial position and convex at its circumference.

(141) An object side surface S**11** of the sixth lens L**6** is convex at its paraxial position and convex at its circumference.

(142) An image side surface S**12** of the sixth lens L**6** is concave at its paraxial position and concave at its circumference.

(143) The object side surfaces and the image side surfaces of the first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all aspherical.

(144) The first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all made of plastic.

(145) In addition, various parameters of the optical system **100** are given in Table 9, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(146) TABLE-US-00009 TABLE 9 Fifth Embodiment f = 3.72 mm, FNO = 2.35, HFOV = 40.7°, TTL = 4.476 mm Surface Surface Surface Y radius Thickness Refractive Abbe Focal length

number name shape (mm) (mm) Material index number (mm) Object plane Spherical Infinite 400 Optical stop Spherical Infinite −0.186 1 Aspherical 1.595 0.582 Plastic 1.546 56.14 4.16 2 First lens Aspherical 4.661 0.082 3 Aspherical 4.380 0.359 Plastic 1.546 56.14 12.48 4 Second lens Aspherical 11.905 0.104 5 Aspherical −11.376 0.250 Plastic 1.666 20.37 −13.62 6 Third lens Aspherical 45.334 0.267 7 Aspherical −36.340 0.469 Plastic 1.645 23.54 −7.98 8 Fourth lens Aspherical 6.019 0.213 9 Aspherical 2.792 0.563 Plastic 1.546 56.14 2.84 10 Fifth lens Aspherical −3.239 0.335 11 Aspherical 42.968 0.332 Plastic 1.546 56.14 −2.41 12 Sixth lens Aspherical 1.273 0.306 13 Infrared Spherical Infinite 0.210 Glass 1.518 64.17 14 filter Spherical Infinite 0.405 15 Image plane Spherical Infinite 0.000

(147) Further, the aspheric coefficients of the image side surfaces or the object side surfaces of the lenses of the optical system **100** are given in Table 10, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(148) TABLE-US-00010 TABLE 10 Fifth Embodiment Aspheric coefficient Surface number 1 2 3 4 5 6 K −4.5063E+00 −2.7815E+01 −2.9778E+01 −5.0000E+01 −5.0000E+01 −5.0000E+01 A4 1.2343E−01 1.7025E−02 1.5768E−02 .sup. −J.0198E−01 −2.9724E−02 7.8166E−02 A6 −3.5574E−02 −1.5097E−01 −1.1558E−01 −3.5503E−01 −4.5040E−01 −1.3055E−01 A8 −1.4887E−01 8.6413E−01 2.9603E−01 5.0015E−01 1.0993E+00 3.0334E−01 A10 5.5035E−01 −4.0326E+00 −6.5899E−01 −4.9904E−01 −2.5839E+00 −1.7700E−01 A12 −9.6839E−01 1.2887E+01 4.7754E−01 −5.3923E−01 5.5318E+00 8.3462E−02 A14 8.4884E−01 −2.5792E+01 1.9889E+00 4.3659E+00 −5.7332E+00 −3.5624E−02 A16 −2.9575E−01 2.9776E+01 −6.9951E+00 −6.5371E+00 2.0932E+00 0.0000E+00 A18 0.0000E+00 −1.7176E+01 9.3333E+00 3.1102E+00 3.8153E−03 0.0000E+00 A20 0.0000E+00 3.7324E+00 −4.2858E+00 0.0000E+00 0.0000E+00 0.0000E+00 Surface number 7 8 9 10 11 12 K 5.0000E+01 −4.0000E+01 −1.0471E+01 −4.0000E+01 −4.0000E+01 −6.6000E+00 A4 −1.1855E−01 −2.3157E−01 −2.6293E−02 5.9267E−02 −3.5643E−01 −2.2035E−01 A6 3.1379E−01 2.7801E−01 −1.1601E−01 −1.4506E−01 1.8077E−01 1.7447E−01 A8 −1.1106E+00 −3.3070E−01 2.6617E−01 1.8389E−01 −2.1699E−02 −1.0091E−01 A10 3.1337E+00 3.3921E−01 −3.5516E−01 −1.2213E−01 −4.7093E−03 4.1607E−02 A12 −6.4922E+00 −2.6336E−01 2.9292E−01 4.2033E−02 −2.6320E−04 −1.1985E−02 A14 9.0173E+00 1.4073E−01 −1.5578E−01 −6.3361E−03 9.6616E−04 2.3053E−03 A16 −7.9609E+00 −4.8976E−02 5.0456E−02 −1.6693E−04 −2.6272E−04 −2.7954E−04 A18 4.0233E+00 1.0470E−02 −8.7868E−03 1.6715E−04 2.9382E−05 1.9344E−05 A20 −8.8841E−01 −1.1096E−03 6.1879E−04 −1.4419E−05 −1.2429E−06 −5.8448E−07

(149) In addition, according to the parameter information provided above, the following relations can be derived:

$CT1/SD11=0.712$; $TTL/CT1=7.69$; $FNO=2.35$; $|f3/f4|=1.707$;
$|f4/f1|+|f5/f6|=3.10$; $f/f12=1.16$; $TT/ImgH=1.08$; $R9/R10=−0.86$;
$|f6|/R12=1.89$; $CT5/|SAG51|=2.61$.

Sixth Embodiment

(150) Referring to FIGS. **11** and **12**, FIG. **11** is a schematic view of an optical system **100** in the sixth embodiment. The optical system **100** includes, sequentially arranged from an object side to an image side, an optical stop STO, a first lens L**1** having a positive refractive power, a second lens L**2** having a positive refractive power, a third lens L**3** having a negative refractive power, a fourth lens L**4** having a negative refractive power, a fifth lens L**5** having a positive refractive power, and a sixth lens L**6** having a negative refractive power. FIG. **12** is, sequentially from left to right, graphs of spherical aberration, astigmatism, and distortion of the optical system **100** in the sixth embodiment.

(151) An object side surface S**1** of the first lens L**1** is convex at its paraxial position and convex at its circumference.

(152) An image side surface S**2** of the first lens L**1** is concave at its paraxial position and concave at its circumference.

(153) An object side surface S**3** of the second lens L**2** is convex at its paraxial position and convex at its circumference.

(154) An image side surface S**4** of the second lens L**2** is concave at its paraxial position and convex at its circumference.

(155) An object side surface S**5** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(156) An image side surface S**6** of the third lens L**3** is concave at its paraxial position and concave at its circumference.

(157) An object side surface S**7** of the fourth lens L**4** is concave at its paraxial position and concave at its circumference.

(158) An image side surface S**8** of the fourth lens L**4** is concave at its paraxial position and convex at its circumference.

(159) An object side surface S**9** of the fifth lens L**5** is convex at its paraxial position and concave at its circumference.

(160) An image side surface S**10** of the fifth lens L**5** is convex at its paraxial position and convex at its circumference.

(161) An object side surface S**11** of the sixth lens L**6** is convex at its paraxial position and convex at its circumference.

(162) An image side surface S**12** of the sixth lens L**6** is concave at its paraxial position and concave at its circumference.

(163) The object side surfaces and the image side surfaces of the first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all aspherical.

(164) The first lens L**1**, the second lens L**2**, the third lens L**3**, the fourth lens L**4**, the fifth lens L**5**, and the sixth lens L**6** are all made of plastic.

(165) In addition, various parameters of the optical system **100** are given in Table 11, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(166) TABLE-US-00011 TABLE 11 Sixth Embodiment f = 3.77 mm, FNO = 2.3, HFOV = 40.4°, TTL = 4.5 mm Surface Surface Surface Y radius Thickness Refractive Abbe Focal length number name shape (mm) (mm) Material index number (mm) Object plane Spherical Infinite 400 Optical stop Spherical Infinite −0.201 1 Aspherical 1.592 0.536 Plastic 1.546 56.14 4.48 2 First lens Aspherical 4.018 0.090 3 Aspherical 3.981 0.410 Plastic 1.546 56.14 9.90 4 Second lens Aspherical 14.560 0.098 5 Aspherical −13.756 0.251 Plastic 1.666 20.37 −11.84 6 Third lens Aspherical 18.630 0.308 7 Aspherical −67.607 0.480 Plastic 1.640 23.80 −8.86 8 Fourth lens Aspherical 6.207 0.217 9 Aspherical 2.709 0.500 Plastic 1.535 55.71 3.00 10 Fifth lens Aspherical −3.757 0.330 11 Aspherical 18.560 0.350 Plastic 1.546 56.14 −2.52 12 Sixth lens Aspherical 1.273 0.311 13 Infrared Spherical Infinite 0.210 Glass 1.518 64.17 14 filter Spherical Infinite 0.409 15 Image plane Spherical Infinite 0.000

(167) Further, the aspheric coefficients of the image side surfaces or the object side surfaces of the lenses of the optical system **100** are given in Table 12, in which definitions of the various parameters can be obtained from the first embodiment, which will not be repeated here.

(168) TABLE-US-00012 TABLE 12 Sixth Embodiment Aspheric coefficient Surface number 1 2 3 4 5 6 K −4.4726E+00 −2.4162E+01 −3.3216E+01 −5.0000E+01 −5.0000E+01 −5.0000E+01 A4 1.2661E−01 9.4027E−03 5.8523E−03 −1.2024E−01 −4.8794E−02 5.1690E−02 A6 −7.4934E−02 −8.3875E−03 5.6976E−02 −2.1807E−01 −2.2636E−01 −8.8972E−03 A8 8.6067E−02 −3.2284E−01 −1.1052E+00 1.7108E−02 3.9936E−01 9.3582E−02 A10 −1.8805E−01 2.1611E+00 5.7261E+00 9.3191E−01 −7.0685E−01 −5.1410E−02 A12 3.4540E−01 −7.9428E+00 −1.7757E+01 −3.6823E+00 1.1541E+00 7.1390E−02 A14

−3.7349E−01   1.8393E+01   3.4405E+01   8.3660E+00   3.7784E−01 −4.1583E−02 A16 1.6987E−01 −2.6033E+01 −4.0595E+01 −9.0180E+00 −2.2093E+00 0.0000E+00 A18 0.0000E+00   2.0714E+01   2.7186E+01   3.6235E+00   1.2001E+00 0.0000E+00 A20 0.0000E+00 −6.8634E+00 −7.8454E+00   0.0000E+00   0.0000E+00 0.0000E+00 Surface number 7 8 9 10 11 12 K   5.0000E+01 −4.0000E+01 −1.0890E+01 −4.0000E+01 −4.0000E+01 −6.2349E+00 A4 −1.4047E−01 −2.4745E−01 −2.5410E−02   8.9961E−02 −3.5416E−01 −2.1720E−01 A6 3.1960E−01   2.8686E−01 −1.2123E−01 −2.3028E−01   1.5534E−01   1.6727E−01 A8 −1.0713E+00 −3.2850E−01   2.9350E−01   3.3376E−01   1.6774E−02 −9.3517E−02 A10 2.9599E+00   2.9330E−01 −4.0252E−01 −2.7518E−01 −3.0863E−02   3.7000E−02 A12 −6.0215E+00 −1.6961E−01   3.3431E−01   1.3450E−01   9.5608E−03 −1.0122E−02 A14 8.2085E+00   4.7643E−02 −1.7849E−01 −4.0166E−02 −1.2251E−03   1.8270E−03 A16 −7.1168E+00   2.2121E−03   5.8899E−02   7.2234E−03   2.7664E−05 −2.0558E−04 A18 3.5386E+00 −4.5285E−03 −1.0723E−02 −7.2244E−04   8.1923E−06   1.3101E−05 A20 −7.7088E−01   7.1432E−04   8.1619E−04   3.1108E−05 −5.8557E−07 −3.6432E−07

(169) In addition, according to the parameter information provided above, the following relations can be derived:

$CT1/SD11=0.636$; $TTL/CT1=8.4$; $FNO=2.30$; $|f3/f4|=1.336$;
$|f4/f1|+|f5/f6|=3.17$; $f/f12=1.18$; $TT/ImgH=1.08$; $R9/R10=−0.72$;
$|f6|/R12=1.98$; $CT5/|SAG51|=1.91$.

(170) Referring to FIG. **13**, in some embodiments, the optical system **100** can be assembled with a photosensitive element **210** to form an image capturing module **200**. In this case, a photosensitive surface of the photosensitive element **210** can be regarded as the image plane S**15** of the optical system **100**. The image capturing module **200** may further be provided with an infrared filter L**7**, and the infrared filter L**7** is arranged between the image side surface S**12** of the sixth lens L**6** and the image plane S**15**. Specifically, the photosensitive element **210** may be a Charge Coupled Device (CCD) or a Complementary Metal-Oxide Semiconductor Sensor (CMOS Sensor). The optical system **100** is used in the image capturing module **200** to enable the head of the camera lens being smaller, which can meet the requirements of miniaturization design of electronic devices.

(171) Referring to FIG. **14**, in some embodiments, the image capturing module **200** may be applied to an electronic device **300**. The electronic device includes a housing **310**, and the image capturing module **200** is mounted on the housing **310**. Specifically, the electronic device **300** may be, but is not limited to, a mobile phone, a video phone, a smart phone, an electronic book reader, a vehicle-mounted camera device such as a car recorder, or a wearable device such as a smart watch. The image capturing module **200** is used in the electronic device **300**, so that the head of the lens in the electronic device **300** is relatively small, which can meet the requirements of the miniaturization design of the electronic device **300**. Further, it can be understood that, in some embodiments, when the electronic device **300** is a smart phone, the lens of the electronic device **300** can be mounted in the housing **310** in an under-screen package manner. In this case, an opening needs to be defined in the screen of the electronic device **300** to expose the lens, so that light rays from the outside of the electronic device **300** can enter the inside of the electronic device **300** through the optical system **100** and form an image on the photosensitive surface of the photosensitive element **210**. The above image capturing module **200** is used in the electronic device **300**, so that the head of the lens is relatively small, and the lens can be exposed when the opening in the screen of the electronic device **300** is smaller, thereby increasing the screen-to-body ratio of the electronic device **300**, and further meeting the requirements of the miniaturization design of the electronic device **300**.

(172) In the description of the present disclosure, it should be understood that the terms "center", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "counterclockwise", "axial", "radial", "circumferential", etc. indicate that the orientation or positional relationship is based on the orientation or positional relationship shown in the drawings,

which is only for the purpose of facilitating the description of the present disclosure and simplifying the description, rather than indicating or implying that the device or elements must have a specific orientation, be constructed and operated in a specific orientation, and therefore cannot be construed as limitation of the present disclosure.

(173) In addition, the terms "first" and "second" are used for purposes of description only, and cannot be understood to indicate or imply relative importance or implicitly indicate the number of technical features indicated. Therefore, the features defined "first" and "second" may explicitly or implicitly include at least one of the features. In the description of the present disclosure, the term "plurality" means at least two, such as two, three, etc., unless specifically defined otherwise.

(174) In the present disclosure, unless otherwise clearly specified and limited, the term such as "mounted", "interconnected", "connected", "fixed" should be understood in a broad sense, for example, it can be a fixed connection or a detachable connection, or integrated; may be a mechanical connection or an electrical connection; may be a direct connection, or may be an indirect connection through an intermediate, may be a communication between two components or an interaction between two components, unless otherwise specified. Those ordinary skilled in the art can understand the specific meanings of the above terms in the present disclosure according to specific situations.

(175) In the present disclosure, unless otherwise clearly specified and defined, the expression that a first feature is "above" or "below" a second feature may indicate that the first and second features are in direct contact, or the first and second features are in indirectly contact through an intermediate. The first feature is "at the top of", "above", and "over" the second feature may indicate that the first feature is directly or obliquely above the second feature, or only indicate that a level height of the first feature is higher than that of the second feature. The expression that a first feature is "beneath", "below", and "under" the second feature may indicate that the first feature is directly or obliquely below the second feature, or only indicates that the horizontal height of the first feature is lower than that of the second feature.

(176) In the description of the present specification, descriptions with reference to the terms such as "an embodiment", "some embodiments", "examples", "specific examples", or "some examples" mean the specific features, structures, materials or characteristics described in conjunction with these embodiments or examples are included in at least one embodiment or example of the present disclosure. In the present specification, the schematic representations for the above terms do not necessarily refer to the same embodiment or example. Moreover, the described specific features, structures, materials or characteristics can be combined in any one or more embodiments or examples in a suitable manner. In addition, those skilled in the art can combine the different embodiments or examples and the features of the different embodiments or examples described in this specification without contradicting each other.

(177) The technical features of the above embodiments can be combined arbitrarily. For concise description, not all possible combinations of the technical features in the above embodiments are described, but all of which should be considered to be within the scope described in this specification, as long as there is no contradiction between them.

(178) The above-mentioned embodiments are merely illustrative of several embodiments of the present disclosure, which are described specifically and in detail, and cannot be understood to limit the scope of the present disclosure. It should be noted that, for those ordinary skilled in the art, several variations and improvements may be made without departing from the concept of the present disclosure, and these are all within the protection scope of the present disclosure. Therefore, the protection scope of the present disclosure shall be subject to the appended claims.

Claims

1. An optical system, sequentially arranged from an object side to an image side, comprising: a first lens having a positive refractive power; a second lens having a refractive power; a third lens having a negative refractive power, an object side surface and an image side surface of the third lens being both concave at circumferences thereof; a fourth lens having a negative refractive power; a fifth lens having a positive refractive power, at least one of an object side surface and an image side surface of the fifth lens having an inflection point; and a sixth lens having a negative refractive power; wherein the optical system satisfies the following relational expressions:

$0.60 < CT1/SD11 < 1.01$;

$5.5 < TTL/CT1 \leq 6.84$; and

$2.2 \leq FNO \leq 2.6$; wherein, CT**1** is a thickness of the first lens on an optical axis, SD**11** is half of a maximum effective aperture of an object side surface of the first lens, TTL is a distance from the object side surface of the first lens to an imaging plane of the optical system on the optical axis, and FNO is an f-number of the optical system.

2. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$3.148 \leq |f3/f4| < 10$; wherein, f3 is an effective focal length of the third lens, and f4 is an effective focal length of the fourth lens.

3. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$2.0 < |f4/f1| + |f5/f6| < 4.0$; wherein, f1 is an effective focal length of the first lens, f4 is an effective focal length of the fourth lens, f5 is an effective focal length of the fifth lens, and f6 is an effective focal length of the sixth lens.

4. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$1.0 < f/f12 < 1.5$; wherein, f is a total effective focal length of the optical system, and f12 is a combined focal length of the first lens and the second lens.

5. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$TT/ImgH < 1.1$; wherein, TT is a distance from the object side surface of the first lens to an image side surface of the sixth lens on the optical axis, and ImgH is half of a diagonal length of an effective pixel area of the optical system on the imaging plane.

6. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$-1.5 < R9/R10 < 0$; wherein, R**9** is a radius of curvature of the object side surface of the fifth lens at the optical axis, and R**10** is a radius of curvature of the image side surface of the fifth lens at the optical axis.

7. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$1 < |f6|/R12 < 2$; wherein, f6 is an effective focal length of the sixth lens, and R**12** is a radius of curvature of an image side surface of the sixth lens at the optical axis.

8. The optical system according to claim 1, wherein the optical system satisfies the following relational expression:

$1.0 < CT5/|SAG51| < 5.0$; wherein, CT**5** is a thickness of the fifth lens on the optical axis, and SAG**51** is a sagittal height of the object side surface of the fifth lens.

9. The optical system according to claim 1, further comprising an optical stop arranged on an object side of the first lens.

10. The optical system according to claim 1, further comprising an infrared cut-off filter arranged on an image side of the sixth lens.

11. The optical system according to claim 1, wherein image side surfaces and object side surfaces

of the first lens, the second lens, the third lens, the fourth lens, the fifth lens, and the sixth lens are aspherical.

12. The optical system according to claim 1, wherein the first lens, the second lens, the third lens, the fourth lens, the fifth lens, and the sixth lens are made of glass.

13. The optical system according to claim 1, wherein the first lens, the second lens, the third lens, the fourth lens, the fifth lens, and the sixth lens are made of plastic.

14. An image capturing module, comprising a photosensitive element and the optical system according to claim 1, the photosensitive element being arranged on the image side of the optical system.

15. The image capturing module according to claim 14, wherein the photosensitive element is a charge coupled device or a complementary metal-oxide semiconductor sensor.

16. An electronic device, comprising a housing and the image capturing module according to claim 14, wherein the image capturing module is mounted on the housing.

17. The electronic device according to claim 16, wherein the image capturing module is mounted in the housing in an under-screen package manner.

18. An optical system, sequentially arranged from an object side to an image side, comprising: a first lens having a positive refractive power; a second lens having a refractive power; a third lens having a negative refractive power, an object side surface and an image side surface of the third lens being both concave at circumferences thereof; a fourth lens having a negative refractive power; a fifth lens having a positive refractive power, at least one of an object side surface and an image side surface of the fifth lens having an inflection point; and a sixth lens having a negative refractive power; wherein the optical system satisfies the following relational expressions:

$0.60 < CT1/SD11 < 1.01$;

$5.5 < TTL/CT1 < 9.0$; and

$3.148 \leq |f3/f4| < 10$; wherein, $CT\mathbf{1}$ is a thickness of the first lens on an optical axis, $SD\mathbf{11}$ is half of a maximum effective aperture of an object side surface of the first lens, TTL is a distance from the object side surface of the first lens to an imaging plane of the optical system on the optical axis, f3 is an effective focal length of the third lens, and f4 is an effective focal length of the fourth lens.