



- (51) **International Patent Classification:**
H04N 5/232 (2006.01)
- (21) **International Application Number:**
PCT/KR2012/010653
- (22) **International Filing Date:**
7 December 2012 (07.12.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
10-2011-0131666 9 December 2011 (09.12.2011) KR
10-2012-0141592 7 December 2012 (07.12.2012) KR
- (71) **Applicant:** LG INNOTEK CO., LTD. [KR/KR]; 20th Fl. Seoul Square 541 Namdaemunno 5-ga, Jung-gu, Seoul 100-714 (KR).
- (72) **Inventor:** LEE, Jung Hyun; 20th Fl. Seoul Square Nam-daemunno 5-ga, Jung-gu, Seoul 100-714 (KR).
- (74) **Agents:** JIN, Cheon Woong et al; 4th FL, Deuk-Young Bldg., 423-5 Dogokdong, Gangnam-Gu, Seoul 135-855 (KR).

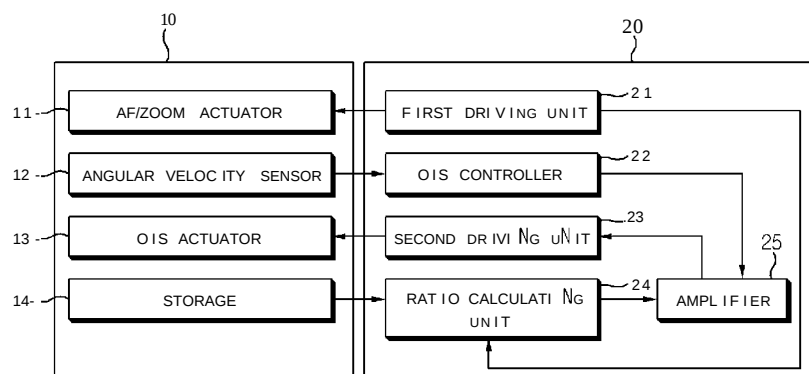
(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** APPARATUS AND METHOD FOR COMPENSATING HAND BLUR



(57) **Abstract:** An apparatus and method for compensating hand blur are disclosed. The method according to an exemplary embodiment of the present invention comprises receiving an angular velocity by tilt of the camera module, determining a first driving signal for driving the second actuator using the angular velocity, calculating a ratio of effective focal length relative to a lens moving distance using the driving of the first actuator, and determining a second driving signal amplifying the first driving signal, using the ratio of effective focal length relative to the lens moving distance.

Description

Title of Invention: APPARATUS AND METHOD FOR COMPENSATING HAND BLUR

Technical Field

[1] The teachings in accordance with exemplary and non-limiting embodiments of this invention relate generally to an apparatus and method for compensating hand blur.

[2]

Background Art

[3] Generally, an exposure time of a camera module increases under a low illumination environment, and under this circumstance, problems including motion blurs caused by a moving target or image blurs such as hand blurs caused by handshake may occur. Likewise, problems occur disabling to photograph a stable video (moving image) due to trembling or shake of a camera module due to generation of tilt by outside trembling.

[4]

[5] In order to prevent the abovementioned conventional problems, camera modules mounted with an OIS (Optical Image Stabilizer) has been used. That is, an OIS is provided to a camera module in the form of an actuator, and shifts a lens along with an AF (Auto Focus) actuator. The OIS is a mechanical actuator capable of horizontally shifting a lens or a barrel mounted with a lens, or tilting a camera itself to a yaw direction or a pitch direction.

[6]

[7] However, the conventional OIS camera module suffers from problems in that a lens shifting or tilt compensation is applied at a fixed focal length, with no consideration of changes in focal lengths including zoom and AF, such that information on an existing fixed focus is inconsistent when the focal length is changed to thereby generating a compensation error.

[8]

Disclosure of Invention

Technical Problem

[9] Accordingly, the present invention has been made keeping in mind the above disadvantages/problems occurring in the prior art, and an object of the present invention is to provide an apparatus for compensating hand blur configured to minimize compensation errors in an OIS (Optical Image Stabilizer) by calculating ratio of effective focal length of a lens moving distance, and a method for compensating hand blur.

[10]

Solution to Problem

- [11] In order to accomplish the above object, in one general aspect of the present invention, there is provided an apparatus for compensating an image blur caused by hand blur of a camera module including a first actuator for AF (Auto Focus)/ zoom, and a second actuator for OIS (Optical Image Stabilizer), the apparatus comprising: a controller determining a first driving signal for driving the second actuator using angular velocity information by tilt of the camera module; a calculator calculating a ratio of effective focal length relative to a lens moving distance, in a case a lens focal length is changed by the first actuator; and an amplifier determining a second driving signal amplifying the first driving signal, using the ratio of effective focal length relative to the lens moving distance.
- [12]
- [13] In some exemplary embodiments, the apparatus may further comprise an angular velocity sensor detecting an angular velocity by the tilt of the camera module.
- [14]
- [15] In some exemplary embodiments, the apparatus may further comprise a first driving unit driving the first actuator.
- [16]
- [17] In some exemplary embodiments, the first driving unit may provide code information based on lens movement to the calculator.
- [18]
- [19] In some exemplary embodiments, the calculator may calculate the ratio of effective focal length relative to the lens moving distance by determining the lens moving distance using the code information based on the lens movement.
- [20]
- [21] In some exemplary embodiments, the apparatus may further comprise storage storing lens moving distance corresponding to the code information based on the lens movement.
- [22]
- [23] In some exemplary embodiments, the calculator may calculate the ratio of effective focal length relative to the lens moving distance by receiving the lens moving distance from the storage.
- [24]
- [25] In some exemplary embodiments, the apparatus may further comprise a second driving unit driving the second actuator using the second driving signal.
- [26]
- [27] In some exemplary embodiments, the controller may obtain an angle tilted by the

camera module by integrating the angular velocity, and determining the first driving signal using a compensation stroke by obtaining the compensation stroke from the tilted angle.

[28]

[29] In another general aspect of the present invention, there is provided a method for compensating image blur caused by hand blur in a camera module including a first actuator for AF (Auto Focus)/ zoom, and a second actuator for OIS (Optical Image Stabilizer), the method comprising: receiving an angular velocity by tilt of the camera module; determining a first driving signal for driving the second actuator using the angular velocity; calculating a ratio of effective focal length relative to a lens moving distance using the driving of the first actuator; and determining a second driving signal amplifying the first driving signal, using the ratio of effective focal length relative to the lens moving distance.

[30]

[31] In some exemplary embodiments, the determining the first driving signal may include obtaining an angle tilted by the camera module by integrating the angular velocity; obtaining a compensation stroke using the tilted angle; and determining the first driving signal using the compensation stroke.

[32]

[33] In some exemplary embodiments, the calculating the ratio may comprise receiving code information based on the lens movement; determining the lens moving distance using the code information; and calculating the ratio of effective focal length relative to the lens moving distance.

[34]

[35] In some exemplary embodiments, the calculating the ratio of effective focal length relative to the lens moving distance may comprise receiving the lens moving distance corresponding to the code information based on the lens movement; and calculating the ratio of effective focal length relative to the lens moving distance.

[36]

[37] In some exemplary embodiments, the second driving signal may be determined by the following Math Figure:

[38]
$$AV' = AV - (1 + Ratio)$$

[39] where, $\Delta V'$ is the second driving signal, ΔV is the first driving signal, *Ratio* is a ratio of effective focal length relative to the lens moving distance.

[40]

[41] In some exemplary embodiments, the method may further comprise driving the second actuator using the first driving signal or the second driving signal.

[42]

Advantageous Effects of Invention

[43] The apparatus and method for compensating hand blur according to the exemplary embodiments of the present invention have an advantageous effect in that image blur can be compensated in response to changes in lens focal length by calculating a ratio of effective focal length (EFL) based on a moving distance (D) on a roll axis of a lens, and reflecting the ratio of EFL on a driving signal of an OIS (Optical Image Stabilizer) actuator.

[44]

[45] Another advantageous effect is that an OIS compensation error can be minimized by compensating the image blur in response to the changes in the lens focal length.

[46]

Brief Description of Drawings

[47] FIG. 1 is an exemplary view explaining a blur compensation error in response to changes in the lens focal length of a camera module according to prior art.

[48] FIG.2 is a block diagram illustrating an apparatus for compensating hand blur according to an exemplary embodiment of the present invention.

[49] FIG.3 is a flowchart illustrating a method for compensating hand blur according to an exemplary embodiment of the present invention.

[50]

Best Mode for Carrying out the Invention

[51] Although the present invention may be devised by numerous other modifications and embodiments, particular exemplary embodiments will be exemplified by the drawings and explained in detail by the Detailed Description of the present invention. However, it should be understood that the present invention is not limited to any particular exemplary embodiments, but encompasses all other modifications, equivalents and variations without departing from the spirit or scope of the invention.

[52]

[53] Now, blur compensation error in response to changes in a lens focal length of a camera module having an OIS (Optical Image Stabilizer) according to the prior art will be illustrated and explained with reference to the accompanying drawings, and exemplary embodiments of the present invention will be explained in detail.

[54]

[55] FIG. 1 is an exemplary view explaining a blur compensation error in response to changes in the lens focal length of a camera module according to prior art, where, in a case P is a position of a principal point of a lens at an infinity (I), a distance on a roll axis (R) from the P to a sensor surface (100) is an EFL (Effective Focal Length).

[56]

[57] Under this circumstance, in a case a camera module is tilted by hand blur as much as " θ " to a yaw axis or a pitch axis, a blur is generated on the sensor surface (100), because an image is moved from a center of R axis. In this case, a compensation stroke (S) relative to the image blur may be obtained by the following Math Figure 1.

[58] MathFigure 1

[Math.1]

$$S = EFL \cdot \tan\left(\theta \cdot \frac{\pi}{180}\right)$$

[59] At this time, a pixel amount to be compensated may be obtained by the following Math Figure 2.

[60]

[61] MathFigure 2

[Math.2]

$$Lens_blur = \frac{S}{Pixel_Pitch}$$

[62] That is, in a case an EFL is fixed and an OIS actuator is generated with a tilt as much as θ in Math Figure 1, a compensation as much as a distance S in Math Figure 1 is required to compensate a pixel in Math Figure 2.

[63] However, in a case a focal length is changed by the lens being positioned at P along the R axis by an AF (Auto Focus) or a zoom actuator, a stroke change AS by a lens moving distance D may be obtained by the following Math Figure 3.

[64]

[65] MathFigure 3

[Math.3]

$$AS = D \cdot \tan\left(\theta \cdot \frac{\pi}{180}\right)$$

[66] Thus, although a total stroke for compensating the blur must be "S+AS", a conventional camera module cannot cope with a stroke change in response to changes in focal length.

[67]

[68] By way of non-limiting example, in a case a tilt is generated on the lens to a yaw axis as much as 1° and to a pitch axis as much as 0.8° , and a focal length of the lens is changed as much as 0.2mm by AF or zoom actuator, an increased amount of image blur in response to the focal length change, i.e., a blur amount to be compensated by the OIS, may be obtained by the following Math Figures (assuming that an EFL is 4.24mm, and a pixel pitch of an image sensor is 0.0014mm, which are general

numerical values).

[69]

[70] MathFigure 4

[Math.4]

$$Lens_blur_Yaw = \frac{0.2 \times 0.017455}{0.0014} \cong 2.5 \{pixel\}$$

[71]

$$Lens_blur_Pch = \frac{0.2 \times 0.013964}{0.0014} \cong 2.0 \{pixel\}$$

[72]

That is, in a case the lens has moved as much as 0.2mm, an increased blur amount on the yaw axis is 2.5 pixels, and an increased blur amount on the pitch axis is 2.0 pixels. Thus, in a case a focal length is changed on the roll axis by the AF or the zoom actuator, the blur must be compensated by reflecting a stroke change corresponding to the changed focal length.

[73]

[74]

In a case an OIS compensation rate is R on a percentage base, and D=0, an OIS compensation deviation error may be obtained by the following Math Figure 5, and an OIS compensation error may be obtained by the following Math Figure 6, in a case a change in focal length is generated as much as the lens moving distance D.

[75]

[76]

MathFigure 5

[Math.5]

$$error = 1 - R$$

[77]

[78]

MathFigure 6

[Math.6]

$$error = 1 - \left\{ \frac{EFL}{EFL + D} \right\} \cdot R$$

[79]

By way of non-limiting example, an OIS camera having a compensation ratio of 0.95 (i.e., 95%) may generate an error of 0.05 (5%), and in this camera, in a case a focal length is changed as much as 0.2mm, a compensation error may increase as much as 4.27% as shown in the following Math Figure 7.

[80]

[81]

MathFigure 7

[Math.7]

$$error = 1 - \left\{ \frac{EFL}{EFL + D} \right\} \cdot R = 1 - \left\{ \frac{4.24}{4.44} \right\} \times 0.95 = 9.27\%$$

[82] Particularly, in a case of a zoom camera module, as the moving distance D is relatively greater than that of an AF camera module, a blur pixel in response to the change in focal length increases, whereby it can be confirmed that an error increases.

[83]

[84] Meanwhile, according to the abovementioned Math Figures 1 and 3, AS may be expressed by the following Math Figure 8.

[85]

[86] MathFigure 8

[Math. 8]

$$\tan\left(Q \cdot \frac{\pi}{180}\right) = \frac{S}{EFL} = \frac{\Delta S}{D}$$

[87]

$$AS = S \cdot \frac{D}{EFL}$$

[88]

[89] The apparatus for compensating hand blur according to an exemplary embodiment of the present invention can change a driving signal for control of an OIS actuator by calculating a ratio of effective focal length (EFL) based on a moving distance (D) on a roll axis of a lens, and compensate an image blue, in a case a change in focal length is generated by AF/zoom actuator, thereby minimizing an OIS compensation error.

[90]

[91] Now, an apparatus for compensating hand blur according to an exemplary embodiment of the present invention will be described with reference to FIG.2.

[92]

[93] FIG.2 is a block diagram illustrating an apparatus for compensating hand blur according to an exemplary embodiment of the present invention.

[94]

[95] Referring to FIG. 2, an apparatus (20) for compensating hand blur (hereinafter referred to as "compensating apparatus") according to an exemplary embodiment of the present invention, which is to receive an angular velocity in response to a tilt from an angular velocity sensor of a camera module (10), and to drive an AF/zoom actuator (11) and an OIS actuator (13) using the angular velocity, includes a first driving unit (21), an OIS controller (22), a second driving unit (23), a ratio calculation unit (24), and an amplifier (25).

[96] Furthermore, the camera module (10) includes an AF/zoom actuator (11), an angular velocity sensor (12), an OIS actuator (13) and storage (14).

[97]

[98] Although detailed configurations of the camera module (10) and the apparatus (20)

for compensating hand blur are separately illustrated for convenience sake, it should be understood that each configuration may be mixed together. By way of non-limiting example, the apparatus (20) may be provided inside the camera module (10).

[99]

[100] The OIS controller (22) receives an angular velocity (ω) of the camera module (10) from the angular velocity sensor (12), integrates the angular velocity, obtains an angle (Θ) tilted by the camera, and determines a compensation stroke (S) corresponding to the angle (Θ) from the Math Figure 1. Furthermore, an electrical driving signal (**AY**) for driving the OIS actuator (13) may be determined using the compensation stroke (S).

[101]

[102] The first driving unit (21) transmits code information based on lens movement to the ratio calculation unit (24), in a case there is a change in a lens focal length.

[103]

[104] The storage (14) stores information of lens moving distance (D) corresponding to the code information based on the lens movement. The storage (14) may be an OTP (One-Time Programmable) EPROM (Erasable- Programmable ROM), for example.

[105]

[106] The ratio calculation unit (24) receives the information on the lens moving distance (D) from the storage (14) to calculate a ratio of an EFL (Effective Focal Length) relative to the lens moving distance (D). Generally, the EFL is determined at the time of manufacturing of a camera. That is, the ratio calculation unit (24) calculates the ratio according to Math Figure 9.

[107]

[108] MathFigure 9

[Math.9]

$$\text{Ratio} = \frac{D}{EFL}$$

[109] Meanwhile, in a case of closed loop system such as a feedback AF, the ratio calculation unit (24) directly determines the lens moving distance (D) using feedback code information in response to the lens movement. That is, the storage (14) may not store the information on focal length corresponding to the code information based on the lens movement, and the ratio calculation unit (24) may calculate the information.

[HO]

[111] The amplifier (25) receives the ratio of EFL relative to the lens moving distance (D) from the ratio calculation unit (24), and amplifies a driving signal in response to the lens movement. In the exemplary embodiment of the present invention, a stroke

(S+AS) of lens to be rotated by the OIS actuator (13) may be expressed by the following Math Figure 10.

[112]

[113] MathFigure 10

[Math. 10]

$$S+\Delta S=S+S \cdot \frac{D}{EFL} \rightarrow \Delta V+\Delta V \cdot \frac{D}{EFL}$$

[114] Thus, the amplifier (25) amplifies the driving signal (AV) received from the OIS controller (22) using AV' of the following Math Figure 11.

[115]

[116] MathFigure 11

[Math. 11]

$$AV'=AV' (1+ Ratio)$$

[117]

[118] In a case the amplifier (25) transmits the amplified driving signal to the second driving unit (23), the second driving unit (23) is driven by the driving signal amplified by the OIS actuator (13) to compensate the image blur. The second driving unit (23) may be a driver IC, for example, but the present invention is not limited thereto.

[119]

[120] FIG.3 is a flowchart illustrating a method for compensating hand blur according to an exemplary embodiment of the present invention.

[121]

[122] Referring to FIG.3, the method for compensating hand blur according to an exemplary embodiment of the present invention is to receive an angular velocity (ω) in response to a camera movement from an angular velocity sensor (12) of a camera module (10) (S41). An OIS controller (22) having received the angular velocity (ω) obtains an angle (Θ) tilted about a yaw axis or a pitch axis of a camera by integrating the angular velocity (ω) and obtains a compensation stroke (S) corresponding to the angle (Θ). Thereafter, the OIS controller (22) determines an electrical driving signal (AY) for driving an OIS actuator (13) (S42).

[123]

[124] In a case a change in lens focal length is received from a first driving unit (21) by driving, by a first driving unit (21), an AF/zoom actuator (S43), the first driving unit (21) transmits code information based on the lens movement to a ratio calculation unit (24).

[125]

[126] The ratio calculation unit (24) receives information on a lens moving distance (D)

corresponding to the code information in response to the lens movement from storage (14), or directly calculates the information on the lens moving distance (D) corresponding to the code information to determine a ratio of an EFL relative to the lens moving distance (D) (S44).

[127]

[128] An amplifier (25) receives the ration of EFL relative to the lens moving distance (D), and amplifies the electrical driving signal (AY) for driving an OIS actuator (13) using AV' of Math Figure 11 (S46), thereby compensating an image blur.

[129]

[130] Although a camera module mounted with a conventional OIS cannot solve an image blur due to increased focal length by an AF or zoom actuator, the exemplary embodiments of the present invention can compensate an image blur by differently controlling a driving signal of an OIS actuator and by calculating a ratio of EFL in response to a lens moving distance (D) on a roll axis, whereby an OIS compensation error can be minimized.

[131]

[132] The previous description of the present invention is provided to enable any person skilled in the art to make or use the invention. Various modifications to the invention will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other variations without departing from the spirit or scope of the invention. Thus, the invention is not intended to limit the examples described herein, but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

[133]

Industrial Applicability

[134]

The apparatus and method for compensating hand blur according to the exemplary embodiments of the invention have an industrial applicability in that image blur can be compensated in response to changes in lens focal length by calculating a ratio of effective focal length (EFL) based on a moving distance (D) on a roll axis of a lens, and reflecting the ratio of EFL on a driving signal of an OIS (Optical Image Stabilizer) actuator, and an OIS compensation error can be minimized by compensating the image blur in response to the changes in the lens focal length.

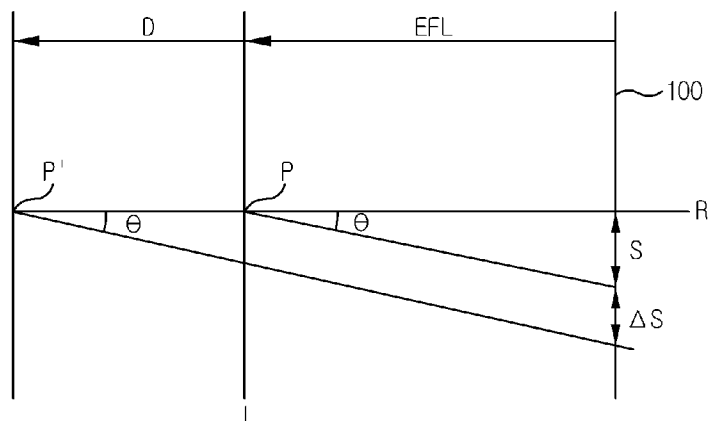
Claims

- [Claim 1] An apparatus for compensating an image blur caused by hand blur of a camera module including a first actuator for AF (Auto Focus)/ zoom, and a second actuator for OIS (Optical Image Stabilizer), the apparatus comprising:
a controller configured to determine a first driving signal for driving the second actuator using angular velocity information by tilt of the camera module;
a calculator configured to calculate a ratio of effective focal length relative to a lens moving distance, in a case a lens focal length is changed by the first actuator; and
an amplifier configured to determine a second driving signal amplifying the first driving signal, using the ratio of effective focal length relative to the lens moving distance.
- [Claim 2] The apparatus of claim 1, further comprising:
an angular velocity sensor configured to detect an angular velocity by the tilt of the camera module.
- [Claim 3] The apparatus of claim 1, further comprising:
a first driving unit configured to drive the first actuator.
- [Claim 4] The apparatus of claim 3, wherein the first driving unit provides code information based on lens movement to the calculator.
- [Claim 5] The apparatus of claim 4, wherein the calculator calculates the ratio of effective focal length relative to the lens moving distance by determining the lens moving distance using the code information based on the lens movement.
- [Claim 6] The apparatus of claim 3, further comprising:
storage configured to store lens moving distance corresponding to the code information based on the lens movement.
- [Claim 7] The apparatus of claim 6, wherein the calculator calculates the ratio of effective focal length relative to the lens moving distance by receiving the lens moving distance from the storage.
- [Claim 8] The apparatus of claim 1, further comprising:
a second driving unit configured to drive the second actuator using the second driving signal.
- [Claim 9] The apparatus of claim 1, wherein the controller obtains an angle tilted by the camera module by integrating the angular velocity, and determines the first driving signal using a compensation stroke by

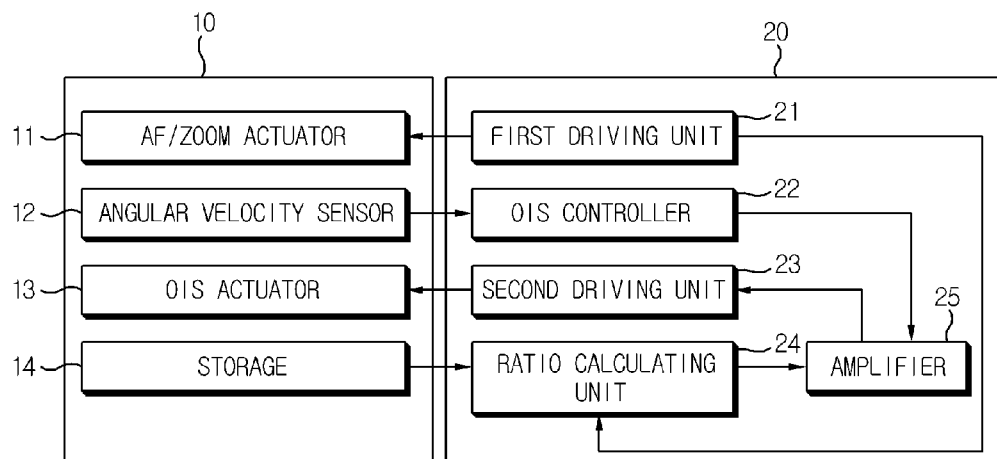
- obtaining the compensation stroke from the tilted angle.
- [Claim 10] A method for compensating image blur caused by hand blur in a camera module including a first actuator for AF (Auto Focus)/ zoom, and a second actuator for OIS (Optical Image Stabilizer), the method comprising:
- receiving an angular velocity by tilt of the camera module;
 - determining a first driving signal for driving the second actuator using the angular velocity;
 - calculating a ratio of effective focal length relative to a lens moving distance using the driving of the first actuator; and
 - determining a second driving signal amplifying the first driving signal, using the ratio of effective focal length relative to the lens moving distance.
- [Claim 11] The method of claim 10, wherein the determining the first driving signal comprises:
- obtaining an angle tilted by the camera module by integrating the angular velocity;
 - obtaining a compensation stroke using the tilted angle; and
 - determining the first driving signal using the compensation stroke.
- [Claim 12] The method of claim 10, wherein the calculating the ratio comprises:
- receiving code information based on the lens movement;
 - determining the lens moving distance using the code information; and
 - calculating the ratio of effective focal length relative to the lens moving distance.
- [Claim 13] The method of claim 10, wherein the calculating the ratio of effective focal length relative to the lens moving distance comprises:
- receiving the lens moving distance corresponding to the code information based on the lens movement; and
 - calculating the ratio of effective focal length relative to the lens moving distance.
- [Claim 14] The method of claim 10, wherein the second driving signal is determined by the following Math Figure:
- $$\Delta Y' = \Delta Y \cdot (1 + Ratio)$$
- where, $\Delta Y'$ is the second driving signal, ΔY is the first driving signal, *Ratio* is a ratio of effective focal length relative to the lens moving distance.
- [Claim 15] The method of claim 10, further comprising:

driving the second actuator using the first driving signal or the second driving signal.

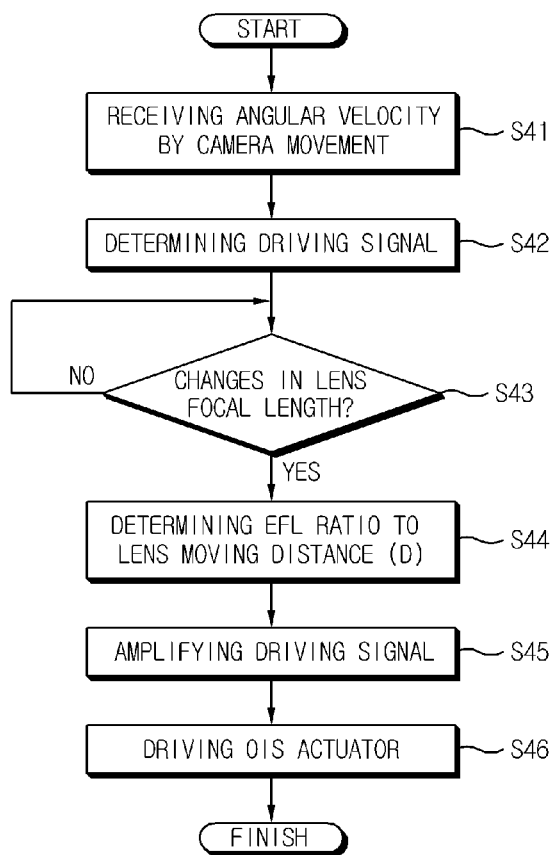
[Fig. 1]



[Fig. 2]



[Fig. 3]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2012/010653**A. CLASSIFICATION OF SUBJECT MATTER*****H04N 5/232(2006.01)i***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N 5/232; H02P 8/00; H02P 8/18; G03B 5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: blur, focus/zoom, focal length, camera

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2006-0088069 A (PENTAX CORPORATION) 03 August 2006 See page 15, lines 3-37; figure 32 and claim 19.	1-15
A	JP 2011-022352 A (CANON INC) 03 February 2011 See abstract; paragraphs [0072]-[0083]; figures 8-9 and claim 6.	1-15
A	JP 2004-348147 A (NIKON CORP) 09 December 2004 See paragraphs [0023H0031]; claims 1-2.	1-15
A	JP 2004-294569 A (NIKON CORP) 21 October 2004 See paragraphs [0024]-[0032]; figure 2 and claim 2.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 FEBRUARY 2013 (15.02.2013)

Date of mailing of the international search report

18 FEBRUARY 2013 (18.02.2013)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan
City, 302-70 1, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KANG, Suk Je

Telephone No. 82-42-481-8322



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2012/010653

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2006-0088069 A	03.08.2006	CN 18 15875 A	09.08.2006
		CN 18 15875 B	02.02.2011
		CN 18 15875 CO	09.08.2006
		GB 2423 159 A	16.08.2006
		GB 2466402 A	23.06.2010
		JP 04-772335 B2	01.07.2011
		JP 2006-208872 A	10.08.2006
		JP 2006-208873 A	10.08.2006
		JP 4772335 B2	14.09.2011
		US 2006-0170388 A1	03.08.2006
		US 77 19225 B2	18.05.2010
JP 2011-022352 A	03.02.2011	None	
JP 2004-348147 A	09.12.2004	JP 3832477 B2	11.10.2006
JP 2004-294569 A	21.10.2004	JP 4363070 B2	11.11.2009