



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.09.2018 Bulletin 2018/39

(51) Int Cl.:
A61H 3/06 (2006.01)

(21) Application number: **17162303.6**

(22) Date of filing: **22.03.2017**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(72) Inventor: **ÖZEL, Ahmet**
45030 Manisa (TR)

(74) Representative: **Ascherl, Andreas et al**
KEHL, ASCHERL, LIEBHOFF & ETTMAYR
Patentanwälte - Partnerschaft
Emil-Riedel-Strasse 18
80538 München (DE)

(71) Applicant: **Vestel Elektronik Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

(54) **A SMART GUIDE DEVICE FOR VISUALLY IMPAIRED PERSON**

(57) The present invention refers to a smart guide device for visually impaired person, wherein the device includes a laser source (101), an ultrasonic sensor (104) provided near the laser source (101), an output mechanism (108) for providing alert to the visually impaired person about any obstacle (109), a gyroscope (102) attached to the laser source (101), a camera (103) for capturing an image (207) of a refracted laser beam (206)

from the obstacle (109), an image processing unit (105) for processing the image captured by the camera (103), an embedded system (106) configured to calculate a height of the obstacle (109) based on the image (207) of the refracted laser beam, the height (205) of the laser source (101) and the angle (201) between a laser beam path (204) and the ultrasonic sensor (104).

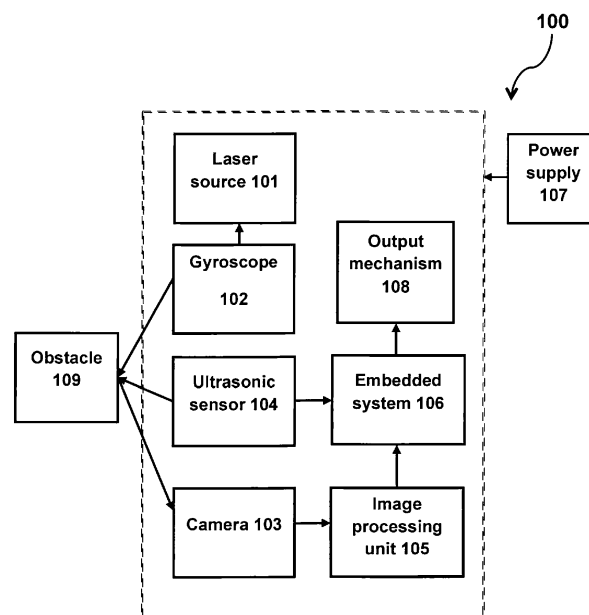


Fig. 1

Description

[0001] This invention refers to a smart guide device for visually impaired person according to claim 1.

Background of the Invention

[0002] For a visually impaired person walking alone without falling down is a difficult task. It's hard for them to walk properly even with stick. There are many devices available in the market. This stick is prudent in alerting the person about an obstacle, while walking. But, such stick may not give the information about whether the obstacle is a pit or a bump on the road. Moreover, the devices cannot give information about the dimensional features of the obstacle. That is if the obstacle is a bump or any other object, the device is not capable to provide information about the height or depth of the obstacle.

[0003] In prior art KR20110078229A, a walking guide device for the blind is disclosed that comprises of an ultrasonic sensor, which senses dynamic and non-dynamic obstacles using an ultrasonic signal, a sensor unit which is equipped with an RFID and grasps location guide information using an RFID signal, a vibrating motor which generates vibration if obstacles are sensed, a controller which controls in order to output walk guiding information, and an output unit which outputs obstacle information by a voice and indicates situation information by an LED.

[0004] In another prior art CN103830071A, a walking stick provided with an infrared detector is shown. An infrared detection head is installed at the front end of a handle of the stick, and an internally-arranged circuit of the infrared detection head is communicated with an alarm prompter on the handle. The handle is provided with a switch used for connecting or disconnecting the infrared detection head. When the stick is used, the infrared detection head can be used for detecting the condition of the road in front in time, the alarm prompter can give sound prompting when an obstacle occurs, and therefore the blind can walk with the walking stick conveniently.

[0005] The subject-matter of the prior arts does not provide information to the visually impaired person about the height or the depth of obstacle. Further, the prior art may not provide the distance of the obstacle from the visually impaired person.

Object of the Invention

[0006] It is therefore the object of the present invention to provide a smart guide device for a visually impaired person to detect or measure the height or depth and distance of any obstacle on the walking direction.

Description of the Invention

[0007] The before mentioned object is solved by providing a smart guide device [herein referred as 'device']

for a visually impaired person to detect or measure the height or depth and distance of any obstacle on the walking direction according to claim 1. According to an embodiment, the device for visually impaired person comprises of a laser source attached to the device for generating laser beam, an ultrasonic sensor provided near the laser source for measuring a height of the laser source from the ground, an output mechanism for providing alert to the visually impaired person about any obstacle on a walking direction, characterized in that a gyroscope is attached to the laser source for maintaining an angle between the laser source and the ultrasonic sensor, a camera for capturing an image of a refracted laser beam from the obstacle, an image processing unit for processing the image captured by the camera, an embedded system configured to calculate a height or depth of the obstacle based on the image of the refracted laser beam from the obstacle, the height of the laser source and the angle between a laser beam path and the ultrasonic sensor.

[0008] Further embodiments are subject-matter of the dependent claims and/or of the following specification parts.

[0009] According to an exemplary embodiment, the camera may be maintained with a fixed focal length and a fixed screen resolution. The image of the refracted laser beam can be captured for a reference object or the obstacle, according to claim 3-8. The image of the refracted laser beam includes a plurality of horizontal pixel lines (HPL); and wherein the image processing unit is configured to measure the number of HPL between laser line on the ground and laser line on the reference object or the obstacle. The number of HPL can be transferred to the embedded system. The image processing unit is further configured to calculate one HPL height using a ratio between the number of HPL measured for the reference object to height of the reference object, wherein the HPL height is stored in the embedded system. A vertical scaling factor is obtained from the height of the laser source from ground and the angle between the laser beam path and the ultrasonic sensor.

[0010] According to another embodiment, the embedded system is further configured for calculating the height or depth of the obstacle based on one HPL height for the reference object, the number of HPL between laser line on the ground and laser line on the obstacle, and the vertical scaling factor. The embedded system further configured for calculating the height or depth of the obstacle using the formula,

$$h = L_r \times N_{go} \times V$$

wherein

h is the height or depth of the obstacle

L_r is one HPL height for the reference object;

N_{go} is the number of HPL between laser line on the ground and laser line on the obstacle; and

V is the vertical scaling factor.

[0011] According to an exemplary embodiment, the embedded system is further configured to measure a distance of the obstacle on the walking direction from the device based on the height of the laser source from ground and the angle between the laser beam path and the ultrasonic sensor. The obstacle can include but not limited to a pit on a ground, a bump on the ground, and any object on the ground.

[0012] Further, the direction of the laser beam refraction can provide information about whether the obstacle is a pit or a bump. The embedded system is further configured to calculate a depth of the obstacle in case the obstacle is a pit. The depth of the obstacle is determined based on the image of the refracted laser beam from the obstacle, the height of the laser source and the angle between the laser beam path and the ultrasonic sensor.

[0013] Further benefits, goals and features of the present invention will be described by the following specification of the attached figures, in which components of the invention are exemplarily illustrated. Components of the devices and method according to the inventions, which match at least essentially with respect to their function can be marked with the same reference sign, wherein such components do not have to be marked or described in all figures.

[0014] The invention is just exemplarily described with respect to the attached figures in the following.

Brief Description of the Drawings

[0015]

Fig. 1 illustrates the block diagram of a smart guide device for visually impaired person according to the present invention;

Fig. 2 illustrates the graphical representation of function of the smart guide device for visually impaired person without obstacle, according to the present invention; and

Fig. 3 illustrates the graphical representation of function of the smart guide device for visually impaired person with obstacle, according to the present invention.

Detailed Description of the Drawings

[0016] Fig. 1 illustrates the block diagram 100 of a smart guide device for visually impaired person, according to the present invention.

[0017] According to an exemplary embodiment, the smart guide device [herein referred as "device"] for visually impaired person comprises of a laser source 101, an ultrasonic sensor 104, an output mechanism 108, a gyroscope 102, a camera 103, an image processing unit 105, an embedded system 106, and a power supply 107.

[0018] According to an embodiment, the laser source 101 is attached to the device and provided for generating laser beam, wherein the generating laser beam is focused towards a walking path of the person. In an embodiment, the ultrasonic sensor 104 is provided near the laser source 101 for measuring a height of the laser source 101 from the ground. In an embodiment, the output mechanism 108 is capable of providing alert to the visually impaired person about any obstacle 109 on a walking direction.

[0019] According to another embodiment, the gyroscope 102 is attached to the laser source 101 for maintaining an angle between the laser source 101 and the ultrasonic sensor 104. In an embodiment, the camera 103 is provided for capturing an image of a refracted laser beam from the obstacle 109. The image processing unit 105 is provided for processing the image captured by the camera 103.

[0020] According to a further embodiment, the embedded system 106 is configured to calculate a height or depth of the obstacle 109 based on the image of the refracted laser beam, the height of the laser source 101 and the angle between a laser beam path and the ultrasonic sensor 104. The power supply 107 is provided for supplying power to the device. In an embodiment, the output mechanism 108 may be a speaker like device or a vibrator or the combination of both to provide alert to the visually impaired person.

[0021] Fig. 2 illustrates the graphical representation 200 of function of the device for visually impaired person without obstacle, according to the present invention.

[0022] According to an exemplary embodiment, the function of the device is started with a transmission of laser beam from the laser source 101. When the laser beam touches the ground 202, the laser beam may get refracted due to disturbance in the straight path 204. The camera 103 is configured to capture the image 207 of the refracted laser beam 206. The camera 103 is maintained with a fixed focal length and fixed screen resolution. That is the view angle 203 of the camera 103 is kept at constant value. The angle 'α' 201 between the laser beam path 204 and the ultrasonic sensor 104 is maintained at a constant by keeping the laser source 101 over the gyroscope 102. The gyroscope 102 enables to move the laser source 101 to keep the angle 201 'α' at constant. Using the trigonometry equation, the distance 204a of the laser beam path 204 from source to ground 202 can be calculated. The distance 204a of laser path 204 can be calculated from the angle 'α' 201 between the laser beam path 204 and the ultrasonic sensor 104 and the height 'h' 205 of the laser source 101 from the ground 202.

[0023] That is,

$$d = \frac{h}{\cos \alpha}$$

[0024] From the above equation, a vertical scaling factor 'V' can be calculated. That is, the vertical scaling factor is obtained from the height 205 of the laser source 101 from ground 202 and the angle 201 between the laser beam path 204 and the ultrasonic sensor 104.

[0025] According to an exemplary embodiment, the image 207 of the refracted laser beam 206 that is captured by the camera 103 is processed to find the height or depth of the obstacle 109. The height or depth of the obstacle 109 is calculated based on comparing the laser beam refraction for a reference object with the obstacle 109. The reference object may be a object with known height or depth. The image 207 of the refracted laser beam 206 includes a plurality of horizontal pixel lines (HPL). The number of HPL between laser line on the ground 202 and laser line on the reference object is measured using the image processing unit 105. Further, the number of HPL between laser line on the ground 202 and laser line on the reference object is transferred to the embedded system 106. From that, one HPL height from the ground 202 for a reference object is calculated based on the number of HPL and height of the reference object. That is,

$$1 \ H_{rhpl} = \frac{N_{rhpl}}{H_r}$$

[0026] Where, N_{rhpl} is number of HPL, H_r is the height or depth of the reference object and H_{rhpl} is one HPL height from the ground 202. The H_{rhpl} value is stored in the embedded system 106 for reference.

[0027] Fig. 3 illustrates the graphical representation 300 of function of the device for visually impaired person with obstacle, according to the present invention.

[0028] According to an exemplary embodiment, the image 207 of the refracted laser beam 206 is processed for the obstacle 109. The number of HPL between laser line on the ground 202 and laser line on the obstacle 109 is measured using the image processing unit 105. The number of HPL between laser line on the ground 202 and laser line on the obstacle 109 is transferred to the embedded system 106. The embedded system 106 can be further configured for calculating the height or depth of the obstacle 109 based on one HPL height for the reference object, the number of HPL between laser line on the ground 202 and laser line on the obstacle 109, and the vertical scaling factor.

[0029] According to a preferred embodiment, the height or depth of the obstacle 109 is calculated using the formula,

$$h_o = H_{rhpl} \times N_{ohpl} \times V$$

wherein

h_o is the height or depth of the obstacle 109;

H_{rhpl} is one HPL height for the reference object;

N_{ohpl} is the number of HPL between laser line on the ground 202 and laser line on the obstacle 109; and

V is the vertical scaling factor.

[0030] According to an exemplary embodiment, the embedded system 106 further configured to measure a distance of the obstacle 109 on the walking direction from the device based on the height 'h' 205 of the laser source 101 from ground 202 and the angle 'α' 201 between the laser beam path 204 and the ultrasonic sensor 104. The obstacle 109 includes a pit on a road, a bump on the road, and any object on the ground 202. The direction of the laser beam refraction provide information about whether the obstacle 109 is a pit or a bump. Hence for the bump and the pit the direction of the refracted laser beam 206 are opposite to each other. In case if the obstacle 109 is a pit, the embedded system 106 can be further configured to calculate a depth of the obstacle 109. The depth of the obstacle 109 is determined based on the image 207 of the refracted laser beam 206 from the obstacle 109, the height 205 of the laser source 101 and the angle 201 between the laser beam path 204 and the ultrasonic sensor 104. The method of calculating the depth of the obstacle 109 is similar to the calculation for the height of the obstacle 109. Further, the device can be wearable on to a body of the person such as belt and so on. Similarly, the device can also be incorporated in any accessories such as stick, guides, umbrella and so on.

[0031] Thus, the present invention refers to a smart guide device for visually impaired person, wherein the device includes a laser source 101, an ultrasonic sensor 104 provided near the laser source 101, an output mechanism 108 for providing alert to the visually impaired person about any obstacle 109, a gyroscope 102 attached to the laser source 101, a camera 103 for capturing an image 207 of a refracted laser beam 206 from the obstacle 109, an image processing unit 105 for processing the image captured by the camera 103, an embedded system 106 configured to calculate a height of the obstacle 109 based on the image 207 of the refracted laser beam, the height 205 of the laser source 101 and the angle 201 between a laser beam path 204 and the ultrasonic sensor 104.

List of reference numbers

[0032]

100 block diagram for the device
101 laser source

102 a gyroscope
 103 a camera
 104 an ultrasonic sensor
 105 an image processing unit
 106 an embedded system
 107 power supply
 108 an output mechanism
 109 an obstacle
 200 graphical representation of function of the device without obstacle
 201 the angle between a laser beam path and the ultrasonic sensor
 202 ground line
 203 view angle of a camera
 204 laser beam path
 204a distance of the laser beam path from source to ground (d)
 205 height of the laser source from the ground (h)
 206 refracted laser beam
 207 image of the refracted laser beam
 300 graphical representation of function of the device with the obstacle

Claims

1. A smart guide device for visually impaired person comprises of:

a laser source (101) attached to the device for generating laser beam;
 an ultrasonic sensor (104) provided near the laser source (101) for measuring a height (205) of the laser source (101) from the ground (202);
 an output mechanism (108) for providing alert to the visually impaired person about any obstacle (109) on a walking direction;

characterized in that

a gyroscope (102) attached to the laser source (101) for maintaining an angle between the laser source (101) and the ultrasonic sensor (104);
 a camera (103) for capturing an image (207) of a refracted laser beam (206) from the obstacle (109);
 an image processing unit (105) for processing the image captured by the camera (103);
 an embedded system (106) configured to calculate a height or depth of the obstacle (109) based on the image (207) of the refracted laser beam, the height (205) of the laser source (101) and the angle (201) between a laser beam path (204) and the ultrasonic sensor (104).

2. The smart guide device of claim 1, wherein the camera (103) is maintained with a fixed focal length and a fixed screen resolution.

3. The smart guide device of claim 1, wherein the image

(207) of the refracted laser beam (206) is captured for a reference object or the obstacle (109).

4. The smart guide device of claim 3, wherein the image (207) of the refracted laser beam (206) includes a plurality of horizontal pixel lines (HPL); and wherein the image processing unit (105) configured to measure the number of HPL between laser line on the ground (202) and laser line on the reference object or the obstacle (109), and to transfer to the number of HPL to the embedded system (106).

5. The smart guide device of claim 4, wherein the image processing unit (105) further configured to calculate one HPL height using a ratio between the number of HPL measured for the reference object to height or depth of the reference object; wherein the HPL height is stored in the embedded system (106).

6. The smart guide device of claim 5, wherein a vertical scaling factor is obtained from the height (205) of the laser source (101) from ground (202) and the angle (201) between the laser beam path (204) and the ultrasonic sensor (104).

7. The smart guide device of claim 6, wherein the embedded system (106) further configured for calculating the height or depth of the obstacle (109) based on one HPL height for the reference object, the number of HPL between laser line on the ground (202) and laser line on the obstacle (109), and the vertical scaling factor.

8. The smart guide device of claim 7, wherein the embedded system (106) further configured for calculating the height or depth of the obstacle (109) using the formula,

$$h_o = H_{rhpl} \times N_{ohpl} \times V$$

wherein

h_o is the height or depth of the obstacle (109)
 H_{rhpl} is one HPL height for the reference object;
 N_{ohpl} is the number of HPL between laser line on the ground (202) and laser line on the obstacle (109); and
 V is the vertical scaling factor.

9. The smart guide device of claim 1, wherein the embedded system (106) further configured to measure a distance of the obstacle (109) on the walking direction from the device based on the height (205) of the laser source (101) from ground (202) and the angle (201) between the laser beam path (204) and the ultrasonic sensor (104).

10. The smart guide device of claim 1, wherein the obstacle (109) includes a pit on a road, a bump on the road, and any object on the ground (202).
11. The smart guide device of claim 1, wherein direction of the laser beam refraction provide information about whether the obstacle (109) is a pit or a bump. 5
12. The smart guide device of claim 1, wherein the output mechanism 108 is a speaker like device or a vibrator or the combination of both to provide alert to the visually impaired person. 10
13. The smart guide device of claim 1, wherein the device is wearable on to a body of the person. 15
14. The smart guide device of claim 1, wherein the device is incorporated in accessories which includes stick, guides, umbrella, and shoe. 20

20

25

30

35

40

45

50

55

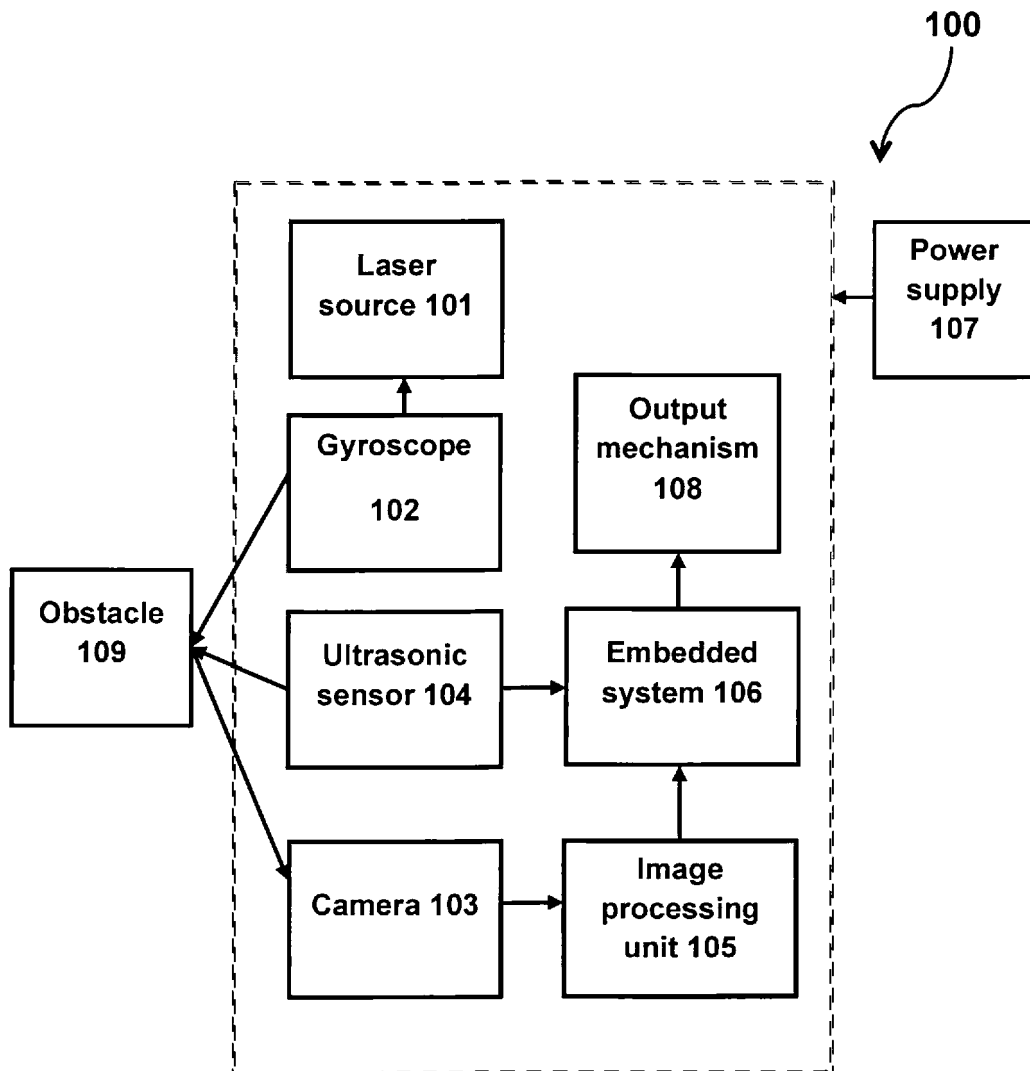


Fig. 1

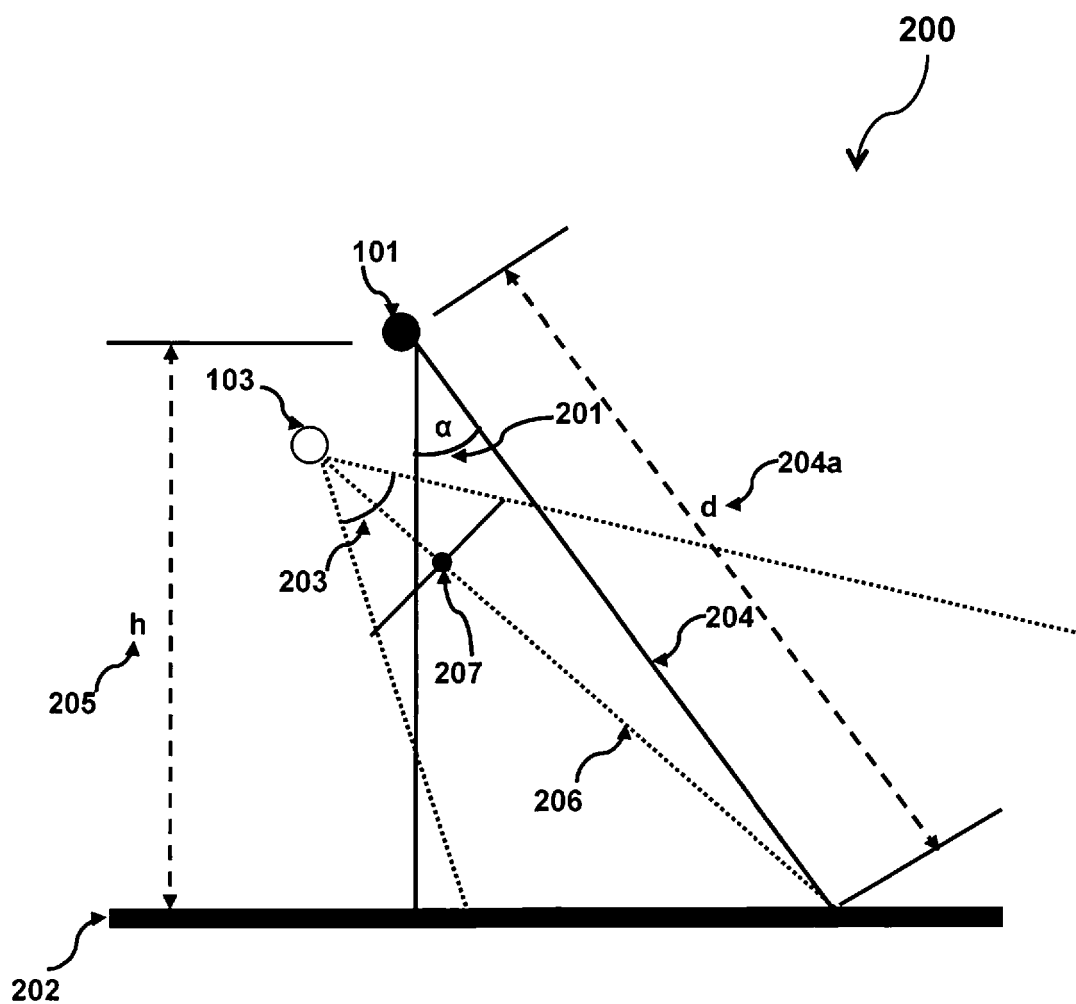


Fig. 2

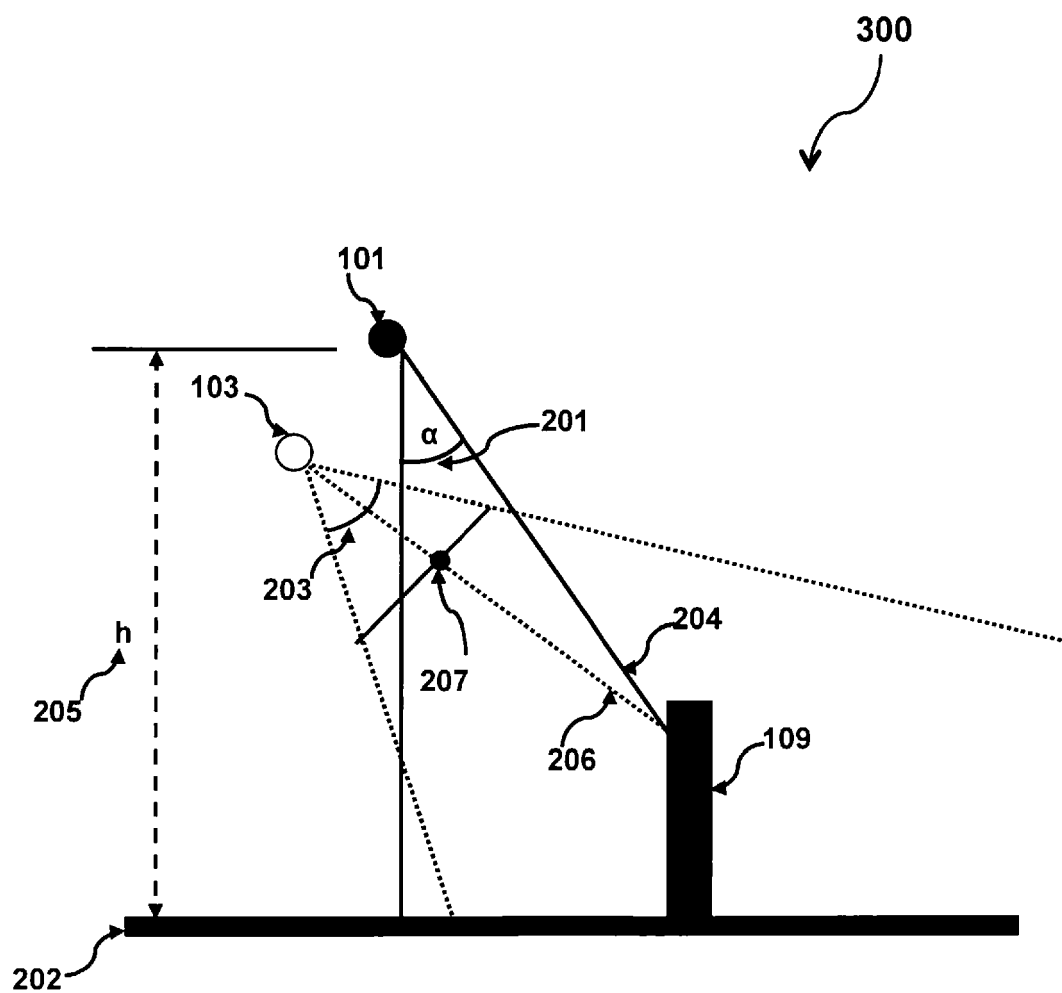


Fig. 3



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 16 2303

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 088 996 A1 (IMMERSION CORP [US]) 2 November 2016 (2016-11-02) * paragraphs [25], [49], [51], [57], [65]; claim 6 *	1-14	INV. A61H3/06
A	----- CN 204 814 723 U (SHENZHEN QIANHAI CLOUDMINDS CO LTD) 2 December 2015 (2015-12-02) * the whole document *	1-14	
A	----- KR 2016 0028891 A (KIM KYOUNG YEON [KR]) 14 March 2016 (2016-03-14) * the whole document *	1-14	
A	----- US 2013/258078 A1 (HUANG YU-CHIEN [TW] ET AL) 3 October 2013 (2013-10-03) * the whole document *	1-14	
A	----- CN 103 584 982 A (GUANGDONG OPPO MOBILE TELECOMM) 19 February 2014 (2014-02-19) * the whole document *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			A61H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 August 2017	Examiner Turmo, Robert
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 16 2303

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-08-2017

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3088996 A1	02-11-2016	CN 106095071 A	09-11-2016
		EP 3088996 A1	02-11-2016
		JP 2016212858 A	15-12-2016
		KR 20160128233 A	07-11-2016
		US 2016321880 A1	03-11-2016

CN 204814723 U	02-12-2015	NONE	

KR 20160028891 A	14-03-2016	NONE	

US 2013258078 A1	03-10-2013	TW 201338769 A	01-10-2013
		US 2013258078 A1	03-10-2013

CN 103584982 A	19-02-2014	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 20110078229 A [0003]
- CN 103830071 A [0004]