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(54) Title: METHOD AND SYSTEM FOR CALIBRATION OF A SENSOR

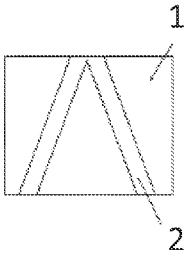


Fig 1

(57) Abstract: The disclosure relates to a method for calibration of a sensor or a scanner comprising the steps of placing the sensor in the area to be monitored, placing detection plates in at least two positions in the area to be monitored, adjusting the height of the sensor to a desired height wherein a reflection from the detection plates is detected by the sensor and displayed on a screen in order for the user to be able to find the optimal height adjustment for the sensor for a specific purpose. The disclosure also relates to a system for calibration of a sensor, comprising a sensor, a frame for the sensor, the height of which may be adjusted, wherein the sensor is placed in an area to be monitored, at least two detection plates which plates are to be placed at separate positions in an area to be detected, a monitor arranged to display the detection of reflections of signals from the sensor, in order for the user to be able to find the optimal height adjustment of the sensor. The disclosure is further directed to a detection plate comprising a background surface with low reflection and an asymmetrical pattern on the background surface made from a material with high reflection that is used in the system according to the invention and when carrying out the method according to the invention.

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METHOD AND SYSTEM FOR CALIBRATION OF A SENSOR

FIELD OF THE INVENTION

The disclosure relates to a method and a system for calibration of a sensor, such as a light or laser based sensor and particularly to a portable sensor for monitoring of the surroundings for example at a sports arena, such as a bowling court, a curling rink, a track or racing track or a warehouse or another open space where motion of an object or a person is to be monitored.

BACKGROUND OF THE INVENTION

Traditionally sensors for scanning the environment have been set up by being placed at a suitable spot in the area to be monitored and then been manually adjusted in one direction, checked by the user, by the user moving a beam detector to a point in the area to check the results of the adjustment, then adjusting again and checking another point in the area with a beam detector, doing more adjustments and usually ending up in rechecking the first point again and so on. This is very time consuming and frustrating for the user. In a non-changing environment where the scanner or sensor may be placed permanently this may not be a problem, but with small modern portable scanners or sensors which may be moved between locations, this is a problem.

BRIEF DESCRIPTION OF THE INVENTION

The object of the present invention is to provide an improved system for calibration of a light or laser-based sensor or scanner, where at least one of disadvantages of the prior art is eliminated or at least alleviated. The objects of the present invention are achieved with a system, method and computer program product according to the characterizing portions of the independent claims.

The present invention is directed to a method for calibration of a sensor or a scanner comprising the steps of placing the sensor in the area to be monitored, placing detection plates in at least two positions in the area to be monitored, adjusting the height of the sensor to a desired height wherein a reflection from the detection plates is detected by the sensor and displayed on a screen in order for the user to be able to find the optimal height adjustment for the sensor for a specific purpose.

The invention is further directed to a system for calibration of a sensor or scanner, comprising means for carrying out said method.

The invention is further directed to a detection plate comprising a background surface with low reflection and an asymmetrical pattern on the background surface made from a

material with high reflection that is used in the system according to the invention and when carrying out the method according to the invention.

The preferred embodiments of the invention are disclosed in the dependent claims.

BRIEF DESCRIPTION OF THE FIGURES

In the following the disclosure will be described in greater detail, in connection with preferred embodiments, with reference to the attached drawings, in which

Figure 1 illustrates one detection plate and asymmetrical pattern according to the invention.

Figure 2 illustrates another detection plate and asymmetrical pattern according to the invention

Figure 3 illustrates another detection plate and asymmetrical pattern according to the invention

Figure 4 illustrates another detection plate and asymmetrical pattern according to the invention

Figure 5 illustrates an alternative embodiment where a cone is used instead of a detection plate.

Figure 6 shows an exemplary user interface according to the invention which may be displayed on a screen to a user.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

The following embodiments are exemplary. Although the specification may refer to “an”, “one”, or “some” embodiment(s), this does not necessarily mean that each such reference is to the same embodiment(s), or that the feature only applies to a single embodiment. Single features of different embodiments may be combined to provide further embodiments.

In the following, features of the invention will be described with a simple example of a device architecture in which various embodiments of the invention may be implemented. Only elements relevant for illustrating the embodiments are described in detail.

The present invention is directed to a system for calibration of a sensor, comprising a sensor, a frame for the sensor, the height of which may be adjusted, wherein the sensor is placed in an area to be monitored, at least two detection plates which plates are to be placed at separate positions in an area to be detected, a monitor arranged to display the detection of reflections of signals from the sensor, in order for the user to be able to find the optimal height adjustment of the sensor.

The invention is also directed to a method for calibration of a sensor, comprising the steps of placing the sensor in the area to be monitored, placing detection plates in at least two

positions in the area to be monitored, adjusting the height of the sensor to a desired height wherein a reflection from the detection plates is detected by the sensor and displayed on a screen in order for the user to be able to find the optimal height adjustment for the sensor for a specific purpose.

Further the invention is directed to a detection plate comprising a background surface with low reflection and an asymmetrical pattern on the background surface made from a material with high reflection.

With the system, method and detection plate according to the invention it is possible to set up sensors or scanners for detection in an efficient and easy manner.

The detection plate according to the invention has a background surface with a low reflection, preferably the background surface material has a matte finish to additionally reduce the reflection of light. Most preferably the background material is black or another dark colour. The detection plate may be curved about a vertical axis or the detection plate may be flat.

The detection plate comprises a pattern on the background material, which pattern is made from a material with high reflection. The pattern is preferably asymmetrical to make it easier for the user to determine what part of the pattern it is that reflects the light. If the pattern is symmetrical it is more difficult, or depending on the pattern, even impossible to determine whether the reflection comes from the desired height or not.

Preferably the material of the pattern has a glossy surface and most preferably the patterns is a reflector. The higher the difference in reflection between the background and the patterns is the easier it is to detect the reflection from the patterns and thus achieve more reliable results.

The method for calibration may be used for all types of light- or laser- based sensors, regardless of whether the light source is a fixed light source or if it is pulsating one. Any Sensor that is based on sending out a light pulse and sensing the reflection will give the needed measurement data for the method according to the invention.

The light sent out by the sensor is reflected back to the sensor and information about distance, angle, intensity of the reflected light, and the position of the reflected light among many others are output from the sensor.

According to the invention the measurement data, i.e. the output information of the sensor is then used and processed in a control unit that processes the output values of the sensor.

The most relevant values for the method according to the invention is the intensity of the reflected light, which will give the information about if the light from the light source is on the correct height or not. Based on the reflection from the detection plate it can be determined in the control unit if the light beam of the sensor is reflected from a highly reflecting surface, as the light intensity of the returning light is thus higher, or from a less reflecting surface, as the light intensity of the returning light is thus low. The control unit will output this information to a screen where it is shown to the user.

Preferably the information will be shown to the user in a graphic format. For example, the difference in light intensity of the reflected light may be shown as different colours to distinguish to the user how much of the light is reflected from the pattern of the detection plate and how much is reflected from the background. The asymmetrical pattern on the plate will also help the user in determining if the light beam is on the correct height, as it may be directly seen from the user interface what part of the light beam hits the reflective pattern.

For example, the patterns on the detection plate may be according to one of the embodiments shown in figures 1-4. In figures 1 and 2 the pattern 2 is A-shaped on the background 1, and the user can determine based on the width of the displayed pattern on the screen on what height the light beam hits the pattern. It is also easy to compare whether the light beam hits both or more detection plates at the same height and thus to adjust the height of the sensor. Additionally, the pattern 2 in figure 2 has a horizontal centreline that will make it even easier to determine when the light beam is on that specific height. This is especially useful when the user needs the sensor to scan a specific height and not just in order to get it levelled at an approximate height.

The patterns shown in figures 3 and 4 both have patterns 2 with a horizontal centreline and additionally asymmetrically placed vertical lines extending from the centreline up and down. The vertical lines are intended for helping the user to see whether the light beam is above or below the centreline.

Figure 5 shows an alternative embodiment according to the invention. Here the reflective material 2 is on the sides of a stepped cone and the top faces of the steps are made of background material.

Figure 6 illustrates a user interface using a detection plate according to figure 4. The leftmost picture shows a case where the light beam is below the centreline, in the rightmost picture the light beam is above the centreline and the middle picture shows the light beam being at the correct height. The black coloured dots represents the light that is reflected back from the reflective pattern, and the grey coloured dots are representing the light reflected from the background.

The user interface is showing the situation in real time, and lets the user adjust the height of the sensor while seeing the impact of any adjustments while doing them. This saves a lot of time and iterations.

The user interface will on the screen show e.g. in different colours or in another distinguishing manner points of reflection of light with higher intensity in a different manner than of point with lower intensity. In other words, depending on the pattern used on the detection pad, if one side of the pattern shown to the use on the screen shows high values of reflection high light intensity and the other lower then according to a preferred embodiment the user interface will tell the user that the sensor is too low or high. If the user interface is showing a straight line of high reflection values this will tell the user that the light beam hits the target, i.e. the centreline correctly and that the sensor is properly set up. If no values are detected, the light beam is not hitting the target at all.

According to one embodiment the user interface shows the user whether the sensor should be lowered or lifted up by displaying an arrow below the image of the reflections. An ok or checkmark is shown when the set up is correct and if the target is not found at all an XX mark is shown to the user.

According to the invention the information from the sensor is output to a control unit, which calculates and processes the data and sends it to a terminal where it is shown to the user on a screen. The terminal may be a computer, a laptop, a pad or a mobile phone among others.

The system according to the invention preferably comprises adjustment means for adjusting the height of the sensor. The adjustment means may be a rack with adjustable feet wherein the sensor is placed. Preferably the rack comprises more than 2 adjustment feet, most preferably three, but also four are possible. The adjustment feet may be individually adjusted in terms of height, thus being able to tilt the sensor to reach the ultimate position for the detection task at hand. For example, detecting the path of a bowling ball requires a different height to detecting movements in a ware house.

When the user wants to calibrate a sensor for a specific task he will place the sensor in a desired location. The placement depends on what is to be detected, again if the intention is to monitor movement of a bowling ball the sensor is placed on the floor, in some other case the sensor may be places higher if the intention is to detect movement at that height.

The detection plates are then placed at a distance from the sensor. The distance may be chosen according to the sensor used for the task, preferably the detection plates are placed inside the range of the sensor in order to be able to detect a reflection from the detection plates. At least two detection plates are used. The most optimal number being three detection plates in order to cover an open area, but in some cases more detection plates may be needed, for example if the ground is very uneven or a lot of obstacles are present or the detected are is 360° around the sensor.

The user then checks the data coming from the sensor by displaying the reflection values from each of the detection plates on the screen. Then he adjusts the sensor by tilting it for each set of data from each detection plate until the reflections from all detection plates show that the sensor is in the correct position. This can all be done without leaving the side of the sensor, which will save a lot of time and is more accurate than using a beam detector by moving it to different locations around the sensor.

CLAIMS

1. A method for calibration of a sensor, comprising the steps of

- placing the sensor in the area to be monitored,

- placing detection plates in at least two positions in the area to be monitored,

- sending light from a light source,

- detecting by the sensor light reflected from the detection plates,

characterized in that

- the detection plates comprise a background surface with low reflection and an asymmetrical pattern on the background surface made from a material with high reflection, and

in that the method further comprises:

- determining by the control unit what part of the pattern in each of the detection plates it is that reflects the light,

- outputting information on said determining on a screen, wherein said information comprises at least information about intensity of reflected light,

- adjusting height of the sensor based on the displayed information in order for the user to be able to find the optimal height adjustment for the sensor for a specific purpose.

2. A system for calibration of a sensor, comprising

- a light source,

- the sensor configured to be placed in an area to be monitored,

- a frame for the sensor, the height of which may be adjusted,

- at least two detection plates configured to be placed at separate positions in an area to be detected and to reflect light emitted by the light source,

- a control unit configured to receive information from the sensor, and

- a monitor,

characterized in that

- the at least two detection plates comprise a background surface with low reflection and an asymmetrical pattern on the background surface made from a material with high reflection,
- the control unit is configured to determine what part of the pattern in each of the detection plates it is that reflects the light, and
- the monitor is arranged to display at least information on intensity of reflections of light from each of the at least two detection plates detected by the sensor, in order for the user to be able to find the optimal height adjustment of the sensor within the frame for a specific purpose.

3. A detection plate for use in the system according to claim 2.

4. The detection plate according to claim 3 wherein the pattern is asymmetrical about a horizontal axis.

5. The detection plate according to claim 3 wherein the background surface material has a matte finish and the pattern has a glossy surface.

6. The detection plate according to claim 4 or 5 wherein the background surface is black, and the pattern is a reflector.

7. The detection plate according to any one of claims 3-6, wherein the plate is curved about a vertical axis.

8. The detection plate according to any one of claims 3-6, wherein the plate is flat.

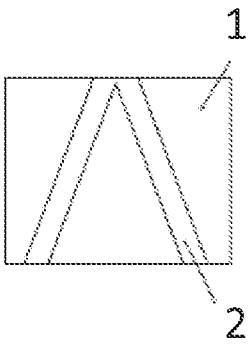


Fig 1

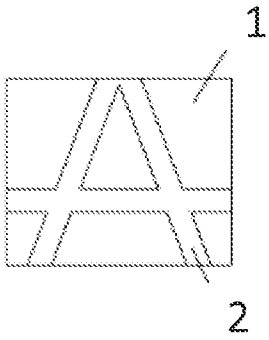


Fig 2

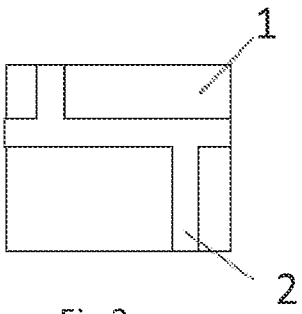


Fig 3

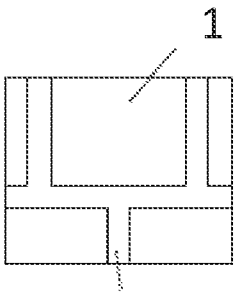
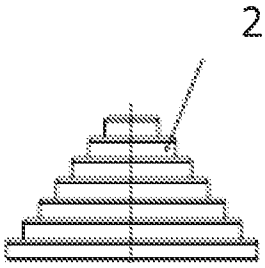


Fig 4



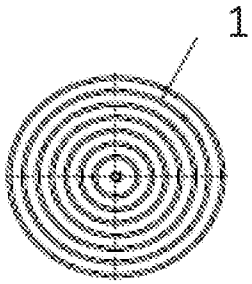


Fig 5

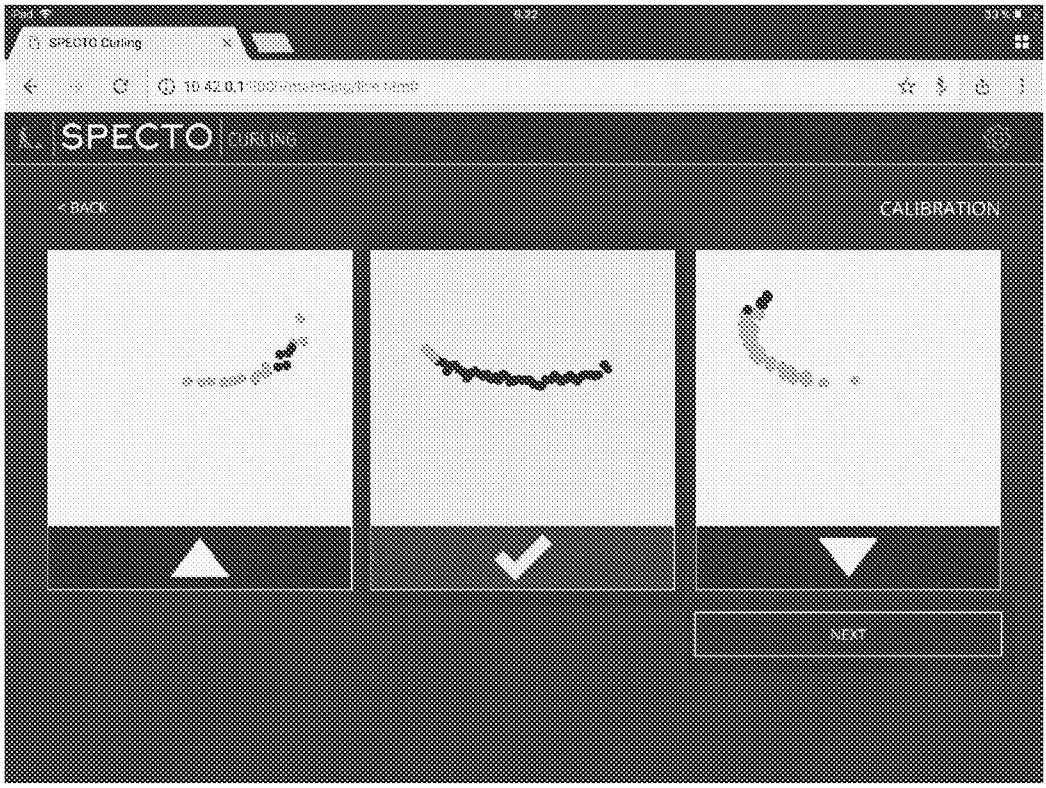


Fig 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2019/050511

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01S7/497 G01S7/481 G01S7/51 G01S17/02
ADD.

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)
G01S G01B G01C

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 176 606 A2 (SICK AG [DE]) 7 June 2017 (2017-06-07) abstract; figures 2 - 4 paragraphs [0010], [0037] - [0039] paragraph [0045] - paragraph [0046] paragraph [0049] - paragraph [0053] paragraphs [0055], [0059] -----	1-6,8
X	US 2010/256940 A1 (OGAWA KAZUHIRO [JP] ET AL) 7 October 2010 (2010-10-07) abstract; figures 6 - 8, 9, 11 paragraphs [0001], [0060] paragraph [0069] - paragraph [0084] paragraph [0096] - paragraph [0100] claim 4 -----	1,3,5,7, 8
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] 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

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Date of the actual completion of the international search	Date of mailing of the international search report
1 October 2019	10/10/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Knoll, Bernhard

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2019/050511

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/258340 A1 (TRUMMER MICHAEL [DE] ET AL) 3 October 2013 (2013-10-03) abstract; figures 1 - 3 paragraphs [0040], [0048], [0050] paragraphs [0055], [0056], [0059] - [0061] paragraphs [0091], [0096], [0102] - [0106] -----	1-6,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

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