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(72) Feltaláló(k):
SCHMITZEK, Peter, 52511 Geilenkirchen (DE)

(73) Jogosult(ak):
CSB-System AG, 52511 Geilenkirchen (DE)

(74) Képviselő:
Danubia Szabadalmi és Jogi Iroda Kft., Budapest

(54) **Berendezés egy vágóállat-test céltárgy bemérésére**

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

Device for measuring a slaughter animal body object

The invention relates to a device for measuring a slaughter animal body object, in particular for measuring relevant structural sections on a surface of the slaughter animal body object.

The use of an electronic camera for optically recording a slaughter animal body object is known from the state of the art. In these methods, the relevant surface is often a so-called cutting side or cutting plane resulting from cutting a slaughter animal body object into two slaughter animal body halves.

The optical image obtained by the camera is subsequently evaluated photogrammetrically by an image analysis method in which different types of tissue are detected and specific line segments and/or areas are computed on the basis of contours and striking reference points.

A method for assessing slaughter animal body objects is disclosed in DE 44 08 604 C2.

In this method, an image of the slaughter animal body to be assessed is taken in front of a blue background and the images recorded are subsequently digitized and stored in a computer.

On the basis of previously defined colour classifiers and frequent colour values, the outer contours of the slaughter animal body are determined first and, then, specific image points or pixels are assigned to the corresponding tissues.

Moreover, the back side of the slaughter animal body is optically recorded, by including a light-section technique, for a three-dimensional object measurement in order to assess the conformation class of the slaughter animal body.

Furthermore, the publications DE 197 33 216 C1, DE 198 47 232 C2 and DE 199 36 032 C1 describe the collection of characteristic measuring values and parameters in the cutting plane of a slaughter animal body by means of an automatic image analysis technique and a subsequent photogrammetric interpretation for evaluation and quality assessment purposes.

To obtain a correct and exploitable measuring result by the known solutions it is particularly necessary that the cutting-side surface is mostly plane and remains aligned orthogonally to the camera level during the entire measurement period.

To align the slaughter animal bodies, they are usually moved relative to the camera level at guiding pipes but due to a partly uneven movement vibrations, rotational movements or torsions around the vertical axis of the slaughter animal body can be caused.

The resulting irregularities have a negative influence on the measurement accuracy for the line sections and areas to be determined at the cutting surface of the slaughter animal body so that a correct measurement result cannot be guaranteed in each case.

In addition to this, a correct measurement of the slaughter animal body requires a defined distance between the slaughter animal body object and the recording cameras. However, this distance can vary due to the unwanted movements of the slaughter animal body during its positioning so that the accuracy of the measurement results can be additionally affected.

Moreover, a plane cutting surface cannot always be ensured because it depends on the processing procedure applied for the slaughter animal body. Furthermore, slaughter animal body objects which are not slaughter animal body halves, show, even idealized, not a plane but an irregular surface which is, for example, the case for ham.

A further disadvantage of the known devices is the fact that the slaughter animal body objects, in particular if they are slaughter animal body halves, are normally exactly positioned relative to the specific camera by a positioning unit which comes unavoidably, at least in sections, into contact with the slaughter animal body objects. But since several slaughter animal body objects are usually positioned one after the other by the same positioning unit and, usually, the positioning unit cannot be cleaned after each slaughter animal body object, a potential hygienic risk exists, in particular if a contaminated slaughter animal body object is positioned.

DE 10 2004 047 773 A1 discloses another option for determining physiological values of a slaughter animal body object, and this method shall make it possible to determine the market value, to calculate the meat and weight portions and, preferentially, to determine exact cutting points for automatic cutting.

In this method, a complete slaughter animal body or parts thereof are recorded by using a topographic technique and the disk-shaped segments of the slaughter animal body objects thus provided are combined to a virtual model.

In the resulting model, compartments of the meat, fat and bone tissues are reproduced so that volumes, line sections and areas within the slaughter animal body object can be determined.

However, the solution described here has the disadvantages that, first, the tomographic method is combined with high technological efforts and considerable costs and that, secondly, only a low throughput of slaughter animal bodies to be measured can be obtained due to the long time required for this procedure.

Furthermore, US 2005/0257748 A1 discloses a device and a method for the volumetric and dimensional measurement of farm animals. This device comprises two 3D cameras so that after the capturing of the volumetric and linear measurement values of the surface of the individual animal the distance between two measurement points can be determined on the basis of the space coordinates recorded.

In publication WO 92/00523 A1, the use of two or three 2D cameras (image cameras) is recommended to determine the dimensions of a slaughter animal body object. In this description, the image cameras provide an image of the slaughter animal body from different perspectives and, on this basis, the measurement data required are computed by an evaluation unit.

WO 2004/12146 A1 discloses an image recording system for recording animals with the object to assess the physical condition of an animal. For this purpose, a pattern is generated on the surface of the animal by using a pattern projector. The image recording system described in this publication comprises two 2D cameras.

Therefore, it is an object of the present invention to provide a device which allows a simple and cost-effective measurement of slaughter animal body objects and, simultaneously, ensures a high measurement accuracy.

This object is achieved by the features defined in claim 1. Preferred further embodiments of the invention are described in the dependent claims.

Slaughter animal body objects within the meaning of the inventive solutions can be complete slaughter animal bodies, slaughter animal body halves or parts such as, for example, ham.

A device for measuring a slaughter animal body object according to the invention comprises an image camera with an image camera recording range, wherein a relevant section of the surface, in the case of a slaughter animal body half it is in particular a surface of the slaughter animal body half on a cutting side, can be optically recorded in this image camera recording range.

In a stationary variant of the device of this invention, the slaughter animal body object is preferably moved by a transport system to pass the image camera such that the relevant section of the surface, in the case of a slaughter animal body half the cutting side of the slaughter animal body half, crosses the image camera recording range.

The image camera recording range is designed, for example, in such a manner that the whole cutting-side surface of the slaughter animal body half can be recorded. However, depending on the application, it is also possible that only one section of the cutting-side surface of the slaughter animal body half is captured in the image camera recording range. Usually, the transport system for slaughter animal body halves comprises roller hooks, whereas the one for other slaughter animal body parts can also consist of conveyer belts.

In any stationary variant, the slaughter animal body object is positioned such that the relevant section of the surface, which is the cutting-side surface of the slaughter animal body half in case of a slaughter animal body half, faces the image camera at least sufficiently to ensure that the relevant sections on the relevant surface, i.e. on the cutting-side surface in case of a slaughter animal body half, are successfully recorded.

According to the invention, the image camera is a 2D camera and allows to record, within the image camera recording range, light intensity values (g) of image points and space coordinates (x, y) of the image points on the cutting-side surface of the slaughter animal body half.

The light intensity values can be acquired, for example, in the known manner by determining grey scale values.

Thus it is, for example, possible to output a light grey scale value for fat tissue existing within the cutting-side surface of the slaughter animal body half or within the relevant surface of another slaughter animal body object, and a dark grey scale value for meat tissue.

The image camera is preferably aligned such that its centre axis, hereinafter also referred to as a normal, is mainly positioned at a right angle to the movement axis of the slaughter animal body object.

In this context, the centre axis is the optical axis of the image camera, whereas the movement axis of the slaughter animal body object is the axis on which the slaughter animal body object is moved through the image camera recording range.

According to a further feature, the image camera of the invention is capable to provide the light intensity values of the image points and the space coordinates assigned to them as light intensity value data for transfer purposes.

Moreover, a device according to this invention comprises an evaluation unit which is connected to the image camera and which captures and processes the light intensity value data provided by the image camera.

The connection between the image camera and the evaluation unit according to the invention can be based on wires or be wireless and allows the transfer of the light intensity value data to the evaluation unit.

The device of the present invention for measuring a slaughter animal body object is characterized by an additional depth camera.

The depth camera has a depth camera recording range in which the relevant section of the surface, which is the cutting-side surface of the slaughter animal body half in case of a slaughter animal body half, can be optically recorded and in which the space coordinates of image points can be registered.

According to the invention, the space coordinates of the image points recorded are composed of the area coordinates (x, y) of these image points and a depth value (z).

The depth camera is capable to provide the space coordinates of the image points as space coordinate data for transfer purposes.

Moreover, the device of the invention is equipped with a positioning unit for positioning the depth camera relative to the image camera.

According to the invention, the depth camera is positioned relative to the image camera in such a manner that the depth-camera recording range and the image-camera recording range overlap at least partially in a common recording range, and the image points to be evaluated by the evaluation unit are located in the common recording range.

Depending on the position of the depth camera and image camera relative to each other, for example horizontally or vertically, the depth camera recording range and the image camera recording range can overlap either horizontally or vertically.

Preferentially, the recording ranges of the depth camera and of the image camera and their position relative to each other is determined such that the common recording range is as large as possible so that the resolution of the depth camera and of the image camera can be best utilized.

In the present invention, the image points are recorded by the depth camera and by the image camera in real time and simultaneously. In this context, simultaneously means that the slaughter animal body object is not moved at all, or almost not at all, between the records made by the image camera and by the depth camera so that the space coordinates (x, y) of the image points recorded by the image camera and by the depth camera can still be assigned to each other.

The real time capability of the depth camera particularly leads to a high frame rate so that the depth camera can simultaneously record space coordinates in the depth camera recording range.

The device of the present invention is also characterized by the connection of the depth camera to the evaluation unit, wherein the evaluation unit collects the space coordinates provided by the depth camera.

This connection makes the transfer of the space coordinate data to the evaluation unit possible and can also be based on wires or be wireless.

According to the invention, the evaluation unit is capable to assign the light intensity value data of image points provided by the image camera to the space coordinate data of image points provided by the depth camera if these image points have identical area coordinates (x, y). On the basis of the data provided by the image camera and by the depth camera, such image points are recorded in the common recording range for which the area coordinates (x, y) and the light intensity value (g) as well as the depth value (z) are registered according to the invention, wherein the area coordinates from the light intensity value data are identical with the area coordinates from the space coordinates.

The light intensity value data and the space coordinate data assigned to each other are advantageously provided as data tuples (x, y, z, g).

Moreover, the evaluation unit of the present invention is capable to identify defined measurement points at the surface of the slaughter animal body half on the basis of the light intensity value data provided by the image camera. The identification of measurement points means that the evaluation unit uses image analysis and object recognition methods to detect characteristic structures at the surface of the slaughter animal body object, for example muscles, fat tissue or bones. On the basis of the light intensity value differences, diverse tissue sections are computationally detected and selected in order to identify the contours of muscles, fat and bones by means of a contour tracking algorithm.

These characteristic structures are used to determine points the position of which relative to each other allows to make statements about quantities and qualities of the slaughter animal body object. The area coordinates of these points are defined as measurement points by the evaluation unit. They serve as a basis for further measurements.

On the basis of the space coordinate data of the data tuple of a first measurement point and of the space coordinate data of the data tuple of a second measurement point, the distance between said points in the space can be determined.

Depending on the requirement, it is possible to determine the Euclidean distance of the measurement points from each other or their distance from each other in the relevant section of the surface, in the case of a slaughter animal body half of the cutting-side surface of the slaughter animal body half, wherein the distances between the measurement points on the relevant side or cutting-side surface are determined by the integration of the spatial distances of sufficiently small sub-distances of the total distance.

Moreover, in this way it is possible with a sufficiently large number of measurement points given to determine areas within the relevant sections of the surface, which is the cutting-side surface in case of slaughter animal body halves, via an integration of sufficiently small sub-areas exactly computed in space.

In both cases, such a procedure can effectively avoid errors in measurement due to uneven or bent surfaces. Depending on the complexness, for example of the cutting-side surface of a slaughter animal body half, it can be useful to smooth the optically recorded surface locally, particularly by involving the depth values of the pixel neighbourhood, and to compute the distance values on the smoothed surface in the sense of a model with an ideally even cutting-side surface in order to increase the measurement accuracy.

Apart from distance measurements, area measurements can also be performed if a sufficiently large number of relevant measurement points exists, and as a result statements can be made about the condition of the slaughter animal body object, for example about lean meat, fat tissue and bone portions, about the position of organic structures, etc. Information about quantitative and qualitative classifications and cutting decisions can be derived from these statements.

Depending on the resolution of the depth camera and of the image camera, the correspondingly recorded image points of the cutting-side surface of the slaughter animal body half are provided in a defined number of image points. Even if the resolution of the depth camera differs from the one of the image camera, the evaluation unit combines the image data in such a manner that, apart from the area coordinates, the light intensity value and the depth value are provided for each image point on the basis of the combined light intensity value data and space coordinate data.

Preferably, the device also comprises means for illuminating the slaughter animal body object, wherein the luminous colour is advantageously selected such that a good image point recording is possible.

Thus, the device of the present invention offers considerable advantages over prior art methods for the measurement of the slaughter animal body object at relevant sections of the surface, in the case of a slaughter animal body half of its cutting-side surface, wherein the advantages particularly exist for the measurement of slaughter animal body halves.

One advantage is a high measurement accuracy because possibly existing irregularities, caused by the distance and angular position of a slaughter animal body half relative to the device and by a possibly uneven, cutting-side surface, can be corrected by the depth value recorded.

Simultaneously, the provisioning and operating costs of such a device can be kept low thanks to the components used in the present invention and, in addition to this, a high throughput of slaughter animal body objects to be measured can be guaranteed.

Due to the integration of the appropriate depth value it is, moreover, not necessary to keep a default distance or a default angle between the slaughter animal body half and the device because the distance information can already be provided by the depth value. Therefore, additional units otherwise required for precisely positioning the slaughter animal body half or for correcting surface unevenness are not necessary any more. Consequently, the provisioning and operating costs of the device of the invention are comparatively low.

Furthermore, the measurement can be taken in a contact-free manner so that hygienic risks caused by accessory devices known from prior art for positioning slaughter animal body halves are avoided and additional steps to minimize these risks are no required any more.

The advantages described also apply for the measurement of other slaughter animal body objects which can be moved, for example, on a conveyor belt. Though a conveyor belt does not cause problems due to uncontrolled movements, the solution of the present invention also offers a specific advantage here, if the positioning of the slaughter animal body object relative to the conveyor belt, in particularly transversally to the longitudinal extension of the conveyor belt, is not accurate. Then, the depth value already provides the distance information which does not only disclose the position of the slaughter animal body object relative to the image camera but also relative to the conveyor belt. As the motion and positioning of the conveyor belt itself can be exactly controlled, it is also possible to exactly predetermine a position of the slaughter animal body relative to units of a downstream station if a further transport to such a downstream station, for example a cutting robot, is programmed, and to control this other unit according to the known position without repeating recording steps.

Thus, the immanent integration of the depth values offers the further particular advantage that the device of the present invention can be applied not only in a stationary variant, i.e. with a defined distance and angle relative to the slaughter animal body object, but also as a mobile device, for example as a hand-held unit. In this way it is also possible to take control or reference measurements to check, for example, the operational reliability and accuracy of other measurement systems.

In a particularly advantageous further development of the invention, the image camera is designed as a colour camera.

The use of a colour camera makes it possible to record the light intensity values separately according to individual colour channels, red, green and blue (RGB) in particular, and to store the light intensity values separately according to colour channels in the light intensity value data and to transfer them to the evaluation unit. Then, the light intensity values can be used for the image analysis according to colour channels so that the contours and structures can be better identified.

In this way, the measurement accuracy of the device of the invention can be additionally optimized.

In another advantageous further development of the invention, the depth value of the space coordinates correspondingly determined is used to identify measurement points at the relevant surface of a slaughter animal body object.

By integrating the depth value information, the measurement points can be better identified, especially in case of an uneven cutting-side surface of a slaughter animal body half. This advantage particularly applies, for example, at the transition of a cutting plane into the abdomen where a characteristic structure can be better identified by the depth information than by the light intensity value data.

In this case, the recordable depth value fulfils a double function because, first, it provides the space coordinates of the measurement points identified from the light intensity value data of the image points and because, secondly, the previous identification of the measurement points, on the cutting-side surface of the slaughter animal body half in particular, is actually made possible or at least supported by the depth value.

In a special manner, the depth information can also be used to separate the slaughter animal body object from the background and thus to define its contour. Depth values which are not within a defined range, particularly beyond a defined value, are then assigned to the background per se by an evaluation algorithm without requiring the integration of the light intensity value data. This method makes it possible to operate without the background walls normally used in the prior art.

As a further advantage, the depth information can also be used if several slaughter animal body objects are positioned close to each other, possibly also contacting each other, which can, for example, be in boxes. In such a case, it is a big problem to separate the slaughter animal body objects from each other by exclusively using the light intensity values of the image points, even if the image camera is a colour camera. The information provided by the depth values can be used to detect recesses and warpages at the object transitions of the slaughter animal body objects and, on the basis of these recesses and warpages, a separation is made possible.

Another advantageous further embodiment tackles a frequently occurring problem concerning the situation in which the real surface shape and a model-like ideal shape of the slaughter animal body object are not the same.

For animal body halves, for example the cutting-side surface is an exact plane according to the model-like ideal shape. The model-like distances between measurement points are based on the ideal model-like shape. The deviation of the real surface shape from the model-like ideal shape leads to the problem that the informative value of the distances recorded between the measurement points in space on the basis of the real surface is not precise.

Among the advantages of the invention is the fact that the distance information, i.e. the z value of the space coordinates, which is provided by the depth camera in any case, can also be used for solving this problem.

As far as the areas with deviations are known, in particular if they always exist at the same place for anatomic or technical reasons, the depth values of points in these areas can be automatically excluded from the generation of the model-like ideal surface or can be less considered for this generation. If these areas are not known, such points are detected out of a plurality of points, which show a deviation beyond a defined value from the ideal model defined by most of the other points and are therefore excluded or less considered. Common procedures, such as RANSAC, can be used for the model adaptation and outlier detection.

On the basis of a model-like ideal surface shape produced in this way, i.e. the plane in case of a slaughter animal body half, the space coordinates of the measurement points determined are projected to the ideal model surface according to the model-like previous knowledge about the cause of the deviation. On the basis of the space coordinates generated in this manner, the distance of the measurement points in space can be then determined.

In a further advantageous variant of the invention, the depth camera is designed as a TOF camera (time-of-flight camera).

A TOF camera makes it possible to determine, in a known manner, a distance between itself and an object recorded by means of transit time technique.

In this method, the object recorded is illuminated by a light pulse and for each illuminated image point the camera determines the time which the light needs to reach the object and to return back from the object to the camera.

The use of a TOF camera has several advantages.

First, TOF cameras have normally a simple design so that they can be provided at relative low costs.

Secondly, TOF cameras realize high frame rates because the complete object is imaged in one record in a very short time. Therefore, TOF cameras are particularly useful for the real time application provided by the invention.

Furthermore, the detection of specific image points, which is required for depth measurements by projection or by means of a stereo camera system, is not necessary.

In other further developments it is possible to use, in particular, stereo camera systems, stereo camera systems with projection and evaluation of a dot pattern, mono camera systems with projection and evaluation of a dot pattern, wherein the depth information is obtained by shifting the dots of the dot pattern.

The invention is explained in more detail in the following figures. They show:

Fig. 1 schematic representation

Fig. 2 schematic representation with ideal surface.

The embodiment includes a device for measuring a slaughter animal body object in form of a slaughter animal body half 1.

A device according to the present invention for measuring a slaughter animal body half 1 comprises an image camera 2 and a depth camera 3.

The image camera 2 of the invention is designed as an RGB camera and has an image recording range with a recording angle $\square_{RGB}$.

Within the image recording range, the image camera 2 can at least partially record a cutting-side surface of the slaughter animal body half 1, here illustrated by the plane axis g_{SKH} of the cutting-side surface.

Moreover, light intensity values (g) of image points and of their area coordinates (x, y) can be recorded by the image camera 2 on the cutting-side surface of the slaughter animal body half 1 in the image recording range.

The light intensity values and area coordinates captured are combined to light intensity value data (x, y, g) and provided for transfer purposes by the image camera 2.

According to the invention, the light intensity value data are transferred to an evaluation unit 3 which is connected to the image camera 2 and which registers and further processes the transferred light intensity value data.

The depth camera 4 provided in the present invention is designed as a TOF camera (time-of-flight camera) and has a depth camera recording range with a recording angle $\square_D$.

In the depth camera recording range, the cutting-side surface of the slaughter animal body half 1 can also be, at least partially, recorded.

Simultaneously, the depth camera 4 can record space coordinates of image points on the cutting-side surface of the slaughter animal body half 1, wherein the space coordinates are always composed of area coordinates (x, y) and a depth value (z).

The space coordinates are provided as space coordinate data (x, y, z) by the depth camera 4 and also transferred to the evaluation unit 3 which is connected to the depth camera 4, too.

According to the invention, a positioning unit 5 positions the image camera 2 and the depth camera 4 relative to each other in such a way that the image camera recording range and the depth camera recording range at least partially overlap each other in an as large as possible common recording range.

On the basis of the light intensity value data recorded by the image camera 2, the evaluation unit 3 of the invention is capable to identify and define discrete measurement points P_1, P_2 at the cutting side surface of the slaughter animal body half 1.

In this way, an object detection of defined sections on the cutting-side surface of the slaughter animal body half 1 is made possible such that, for example, image points with high light intensity value data are assigned to fat tissue sections and image points with low light intensity value data are assigned to meat tissue sections. On the basis of the different light intensity value data, the differentiation between light-intensive image points and faint image points and, thus, the differentiation between fat and meat tissue sections is possible then.

This information is subsequently used to determine the measurement points P_1 and P_2 such that they mark, for example, the outer edges of a fat tissue section.

Moreover, the evaluation unit 3 of this invention is capable to assign the light intensity value data provided by the image camera 2 and the space coordinate data provided by the depth camera 4 to each other on the basis of matching area coordinates and thus to determine the appropriate depth value for each measurement point P_1, P_2.

In addition to this, the evaluation unit 3 can combine the light intensity value data and the space coordinate data to data tuples, wherein one data tuple can be assigned to each measurement point P_1, P_2 and wherein, in a particular advantageous manner, the spatial distance between the measurement points P_1, P_2 can be determined on the basis of their corresponding data tuples.

Therefore, it is the particular technological advantage that the measurement of the cutting-side surface of the slaughter animal body object 1 and the object detection of relevant sections at the surface are made possible by adding the depth value to the otherwise normally used, two-dimensional area information in order to allow a three-dimensional object detection on the cutting-side surface of the slaughter animal body half 1.

In the device of the present invention, the image camera 2 and the depth camera 4 are arranged such that the corresponding recording ranges of the cameras at least partially overlap each other in a common recording range.

In the common recording range, the image points are recorded in real time, i.e. the slaughter animal body object 1 has not been moved relative to the device at all or almost not at all between the capture by the image camera 2 and the capture by the depth camera 4.

The image camera 2 and the depth camera 4 are positioned such in the device of the present invention that the normal n_{RGB} of the image camera 2 and the normal n_D of the depth camera 4 run in parallel to each other as far as possible and that a distance d between the cameras is set such that a sufficiently large common recording is obtained.

During the measurement by means of an inventive device, a transport system, which is a pipe transport system here (not shown), transports the slaughter animal body half 1 on a movement axis g_1 in such a manner that it passes the device.

Thanks to the integration of the corresponding depth values it is a particular advantage that the slaughter animal body object 1 must not be exactly aligned relative to the device.

In fact, it is sufficient if the cutting-side surface of the slaughter animal body half 1 faces the image camera 2 and the depth camera 4 so that the relevant measurement points P_1, P_2 can be clearly identified and that a sufficiently high resolution of pixels is given.

Thus, compared to common solutions, the device of the present invention offers the technological advantages that a very precise measurement of the cutting-side surface of the slaughter animal body half 1 and an exact object detection of relevant surface sections, such as for example fat, meat or bone tissues, can be performed automatically and that, simultaneously, possible measurement irregularities due to an inaccurately positioned slaughter animal body half 1 or an existing unevenness of the cutting-side surface of the slaughter animal body half 1 can be compensated by integrating the depth values.

Fig. 2 shows a particularly advantageous embodiment of the invention in which, for the purpose of simplification, the positioning unit and the movement axis of the slaughter animal body half 1 are not represented once more.

The slaughter animal body half 1 illustrated in Fig. 2 has a real surface shape which is not identical with a model-like ideal shape; in the embodiment a plane is assumed to be the ideal shape. The deviation of the real surface shape is illustrated by the position of the first measurement point P_1. The measurement point P_1 determined is not positioned on the model-like ideal shape of the cutting-side surface, illustrated as a plane axis g_{SKH} in Fig. 2.

Due to the deviation of the determined measurement point P_1 from the idealized cutting-side plane, a deviating distance of the measure points in space would be the result on the basis of the real surface shape.

To reduce the inaccuracy caused by such measurement points which deviate from the ideal plane, several representative auxiliary points H_1 to H_3 are determined on the cutting-side surface of the slaughter animal body half 1 in a first step of the further embodiment according to Fig. 2. In a next step, these auxiliary points are used to define an idealized cutting-side plane, represented by the straight line g_{SKH}.

In a subsequent step of the present invention, the deviating measurement point P_1 is projected to the idealized cutting-side plane and, thus, the projected measurement point P_1' is created. The z value, which corresponds to the z value of the idealized cutting-side plane in the point of the corresponding area coordinates, is assigned to the measurement point P_1.

Now, a distance between the measurement point P_1' and an additionally determined measurement point P_2 can be defined and further used for a distance and/or area measurement so that a higher accuracy can be obtained.

LIST OF REFERENCE NUMERALS

1	slaughter animal body half
2	image camera
3	evaluation unit
4	depth camera
n_{RGB}	image camera normal
n_D	depth camera normal
n_K	slaughter animal body normal
g_{SKH}	plane axis of the slaughter animal body half
g_s	movement axis of the slaughter animal body half
g_m	projection axis of the first measurement point
$\square_{RGB}$	image camera recording angle of image camera
$\square_{D}d$	depth camera recording angle

$\alpha_{C,RGB}$	angle between slaughter animal body half and image camera
P_1	first measurement point
P_2	second measurement point
P_1'	projected first measurement point on ideal surface
H_1	first auxiliary point
H_2	second auxiliary point
H_3	third auxiliary point

Berendezés egy vágóállat-test céltárgy bemérésére

Szabadalmi igénypontok

1. Berendezés egy vágóállat-test céltárgy (1) bemérésére, amely berendezés tartalmaz egy képalkotó kamerát (2) ezen képalkotó kamera egy olyan rögzítési tartományával, amellyel a vágóállat-test céltárgy felületének egy szakasza optikailag rögzíthető, és amelyben képpontok fényerősség-értékei és azok felületi koordinátái foghatók be, ahol a fényerősség-értékek és a hozzárendelt felületi koordináták fényerősségérték-adatokként átvihetően rendelkezésre bocsáthatók,

továbbá tartalmaz a berendezés egy kiértékelő egységet (3), ahol a kiértékelő egység össze van kötve a képalkotó kamerával (2) és ahol a kiértékelő egység rögzíti a képalkotó kamera (2) által rendelkezésre bocsátott fényerősségérték-adatokat,

azzal jellemezve,

hogy a berendezés egy mélységi kamerával (4) rendelkezik, amelynek szintén van egy rögzítési tartománya, amelyben a vágóállat-test céltárgy felületének a szakasza optikailag rögzíthető, és amelyben képpontok térbeli koordinátái foghatók be, ahol a térbeli koordináták felületi koordinátákból és egy mélységi értékből állnak és ahol a térbeli koordináták térbeli koordináta adatokként átvihetően rendelkezésre bocsáthatók,

és hogy a berendezés egy pozicionáló szerkezettel rendelkezik a mélységi kamera (4) pozicionálására a képalkotó kamerához (2) képest, ahol a pozicionálás oly módon történik, hogy a mélységi kamera rögzítési tartománya és a képalkotó kamera rögzítési tartománya egy közös rögzítési tartományban legalább részben átfedi egymást,

és hogy a mélységi kamera (4) össze van kötve a kiértékelő egységgel (3), ahol a kiértékelő egység (3) rögzíti a mélységi kamera (4) által rendelkezésre bocsátott térbeli koordinátákat és ahol a fényerősségérték-adatokból mérési pontok (P_n) azonosíthatók be a vágóállat-test céltárgy felületének a szakaszán, és ahol a fényerősségérték-adatok és a térbeli koordináta adatok egymással megegyező felületi koordináták alapján hozzárendelhetők, és ahol a hozzárendelt fényerősségérték-adatok és térbeli koordináta adatok rendezett adathalmazokként rendelkezésre bocsáthatók, és ahol egy első mérési pont (P_1) képpontjának rendezett adathalmazához tartozó térbeli koordináta adatok és egy második mérési pont (P_2) képpontjának rendezett adathalmazához tartozó térbeli koordináta adatok alapján meghatározható a távolság a két mérési pont (P_1, P_2) között a térben.

2. Az 1. igénypont szerinti berendezés, *azzal jellemezve*, hogy a vágóállat-test céltárgynál egy hasított vágóállat-féltestről (1) van szó, amelynek van egy hasított oldala, a felület szakaszáról beszélve pedig a hasított oldal felületéről van szó, és hogy a képalkotó kamera rögzítési tartományával és a mélységi kamera rögzítési tartományával mindenkor a vágóállat-féltest hasított oldalának felülete optikailag rögzíthető.

3. Az 1. vagy 2. igénypont szerinti berendezés, *azzal jellemezve*, hogy a képalkotó kamera (2) színérték-kameraként van kialakítva, és hogy a fényerősség-értékek külön-külön színcsatornák szerint rögzíthetők, ahol a fényerősség-értékek külön-külön színcsatornák szerint a fényerősségérték-adatokban állnak rendelkezésre.

4. Az előző igénypontok bármelyike szerinti berendezés, *azzal jellemezve*, hogy a mélységi érték a mindenkor megállapított térbeli koordinátákból felhasználható egy mérési pont (P_1, P_2) beazonosításához a vágóállat-test céltárgy felületének a szakaszánál.

5. Az előző igénypontok bármelyike szerinti berendezés, *azzal jellemezve*, hogy a mélységi érték egy vágóállat-test céltárgy felületének a szakaszán levő több pont mindenkor megállapított térbeli koordinátáiból felhasználható egy modellszerű ideális felületi alak meghatározásához, és a beazonosított mérési pontok (P_1, P_2) távolsága a térben egy olyan mélységi érték alapján állapítható meg, amely a modellszerű ideális felületi alaknak felel meg.

6. Az előző igénypontok bármelyike szerinti berendezés, *azzal jellemezve*, hogy a mélységi kamera (4) TOF-kameraként van kialakítva.

Fig. 1

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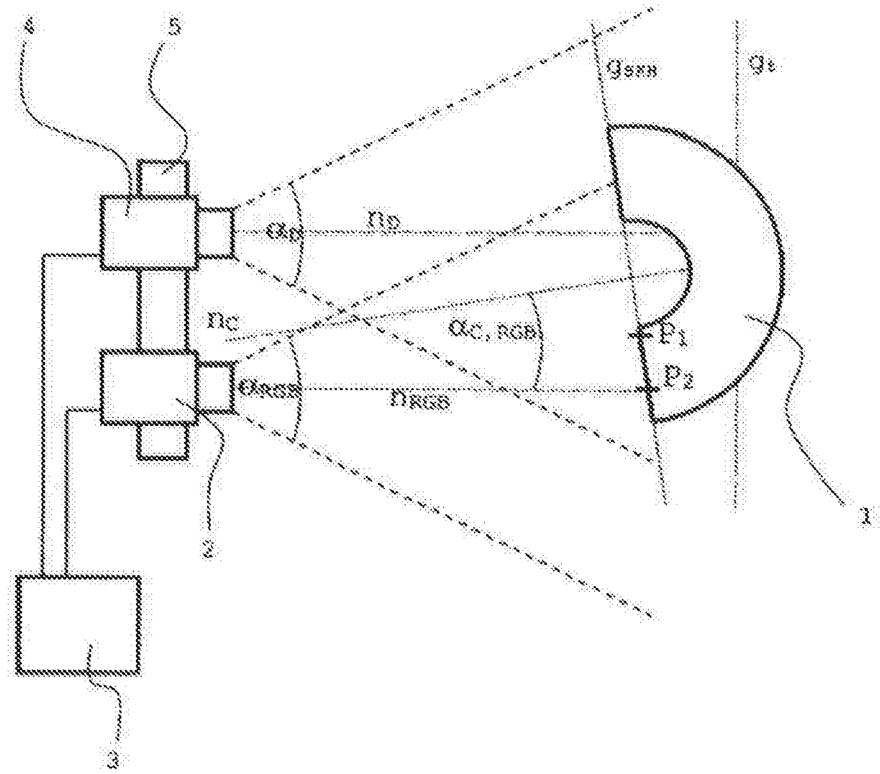

Fig. 2