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(54) **INTRAORAL THREE-DIMENSIONAL MEASURING DEVICE, INTRAORAL THREE-DIMENSIONAL MEASURING METHOD, AND INTRAORAL THREE-DIMENSIONAL MEASUREMENT RESULT DISPLAY METHOD**

VORRICHTUNG ZUR INTRAORALEN DREIDIMENSIONALEN MESSUNG, VERFAHREN ZUR INTRAORALEN DREIDIMENSIONALEN MESSUNG UND VERFAHREN ZUR ANZEIGE DER ERGEBNISSE EINER INTRAORALEN DREIDIMENSIONALEN MESSUNG

DISPOSITIF ET PROCÉDÉ DE MESURE TRIDIMENSIONNELLE INTRA-ORALE ET PROCÉDÉ D'AFFICHAGE DE RÉSULTAT DE MESURE TRIDIMENSIONNELLE INTRA-ORALE

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

[0001] The present invention relates to an intraoral three-dimensional measuring device and an intraoral three-dimensional measuring method for capturing an image of light directed toward an intraoral measurement target such as, for example, a tooth and performing an image analysis process to measure a three-dimensional shape of the measurement target, and also relates to an intraoral three-dimensional measurement result display method.

2. Description of the Prior Art:

[0002] Devices and methods for measuring a three-dimensional shape of a measurement target by any of various methods such as, for example, a light-section method, a focus method, a spatial coding method, a phase shift method, a stereo method, a photogrammetric method, a SLAM method and the like have been proposed and put into practice. For example, a shape measuring device described in Patent Document 1 is operated as follows. Light for projection passes a lattice-pattern plate to be lattice-pattern light. This light is projected onto, and reflected by, a measurement target. An image of the reflected light is captured. Based on the image, a three-dimensional shape of the measurement target is measured. In the field of dental treatment in recent years, such a shape measuring device is used to measure a three-dimensional shape of a dental arch. Thus, such a shape measuring device is applied for, for example, producing artificial teeth and designing prostheses.

[0003] However, the measuring device described in Patent Document 1 (measuring device Z in FIG. 11(a)) is not usable to measure, for example, the entirety of a dental arch Da, which expands over a wide measurement range in an intraoral space, which is narrow, at one time. The reason is as follows. The dental arch as the image capturing subject has a complicated shape, and there are many dead angles in the case where image capturing is performed merely once. The resultant three-dimensional data has many missing parts.

[0004] For the above-described reason, the measurement needs to be performed as follows. As shown in FIG. 11(a), a plurality of narrow ranges Rn, each of which is a part of the measurement target, are measured (hereinafter, referred to as "narrow range measurement"). The narrow ranges Rn are defined such that the narrow ranges Rn cover the entirety of the wide measurement target and also such that adjacent narrow ranges Rn have overlap portions Rr. FIG. 11(b) shows narrow range measurement results In'. As shown in FIG. 11(c), the adjacent narrow range measurement results In' are joined together based on the overlap portions Rr. As a result, an entire measurement result Ic' is acquired as the measurement result on the entirety of the wide measurement target.

[0005] However, when two adjacent narrow range measurement results In' are joined together, there occurs an error although being small. As shown in FIG. 11(d), when such adjacent narrow range measurement results In' are joined together sequentially to form the entire measurement result Ic', such small errors are accumulated. As a result, the entire measurement result Ic' may undesirably have a large error.

[Prior Art Document]

[Patent Document]

[0006] Patent Document 1: Japanese Laid-Open Patent Publication No. 2011-242178 US 2014/0146142 A1 discloses a measuring device used in the dental field and aimed at measuring in the absence of projection of active or structured light.

SUMMARY OF THE INVENTION

[Problems to be Solved by the Invention]

[0007] The present invention has an object of providing an intraoral three-dimensional measuring device in accordance with the independent claim 12 and an intraoral three-dimensional measuring method in accordance with the independent claim 1 capable of accurately performing three-dimensional measurement on a wide measurement range in an intraoral space, which is narrow, and also providing an intraoral three-dimensional measurement result display method in accordance with claim 10.

[Means for Solving the Invention]

[0008] The present invention is directed to an intraoral three-dimensional measuring method including a wide range three-dimensional measurement information acquisition step of acquiring wide range three-dimensional measurement information on a three-dimensional shape measured on a wide range in a desirable measurement range in an intraoral space; a narrow range three-dimensional measurement information acquisition step of acquiring a plurality of pieces of narrow range three-dimensional measurement information each on a three-dimensional shape measured on a narrow range narrower than the wide range in the measurement range; and a synthetic three-dimensional information creation step of locating the plurality of pieces of narrow range three-dimensional measurement information based on the wide range three-dimensional measurement information by use of, as a synthesis reference, intra-measurement range position information common to the wide range three-dimensional measurement information and each of the plurality of pieces of narrow range three-dimensional measurement information, to create synthetic three-dimensional information on the measurement range.

[0009] The present invention is also directed to an intraoral three-dimensional measuring device including a measurement information acquisition unit acquiring wide range three-dimensional measurement information on a three-dimensional shape measured on a wide range in a desirable measurement range in an intraoral space, and acquiring a plurality of pieces of narrow range three-dimensional measurement information each on a three-dimensional shape measured on a narrow range narrower than the wide range in the measurement range; and a synthetic three-dimensional information creation unit locating the plurality of pieces of narrow range three-dimensional measurement information based on the wide range three-dimensional measurement information by use of, as a synthesis reference, intra-measurement range position information common to the wide range three-dimensional measurement information and each of the plurality of pieces of narrow range three-dimensional measurement information, to create synthetic three-dimensional information on the measurement range.

[0010] The wide range in a desirable measurement range described above may be the entirety of the desirable measurement range, a part of the desirable measurement range that is wider than the narrow range, or an entire measurement range formed by joining a plurality of pieces of three-dimensional measurement information on parts of the desirable measurement range that are each narrower than the wide range and wider than the narrow range, the joining being performed at an overlapping portion of each piece of three-dimensional measurement information.

[0011] The measurement range may be the entirety of the dental arch including the gum in the intraoral space, a predetermined region of the dental arch, or the entirety of, or a part of, edentulous jaw.

[0012] The wide range three-dimensional measurement information, the narrow range three-dimensional measurement information, and the synthetic three-dimensional information described above may be numerical information such as spatial coordinate information, direction vector information of texture, reliability information on the measured value or the like, or image information.

[0013] According to the present invention, three-dimensional measurement on the wide measurement target in the narrow intraoral space is accurately performed.

[0014] This will be described in more detail. According to the above-described method, wide range three-dimensional measurement information on a three-dimensional shape measured on a wide range in a desirable measurement range in an intraoral space, and a plurality of pieces of narrow range three-dimensional measurement information each on a three-dimensional shape measured on a narrow range narrower than the wide range in the measurement range, are acquired. The plurality of pieces of narrow range three-dimensional measurement information are located based on the wide range three-dimensional measurement information by use of, as a synthesis reference, intra-measurement range position information common to the wide range three-dimensional measurement information and each of the plurality of pieces of narrow range three-dimensional measurement information, to create synthetic three-dimensional information on the measurement range. The synthetic three-dimensional information on the measurement range created in this manner includes the narrow range three-dimensional measurement information based on the wide range three-dimensional measurement information. Thus, three-dimensional measurement on the entirety of the measurement range is accurately performed with no accumulation of errors.

[0015] In an embodiment according to the present invention, the wide range three-dimensional measurement information may be used to create wide range three-dimensional image information on the three-dimensional shape of the wide range; the plurality of pieces of narrow range three-dimensional measurement information each may be used to create narrow range three-dimensional image information on the three-dimensional shape of the narrow range; and in the synthetic three-dimensional information creation step, synthetic three-dimensional image information may be created based on the synthetic three-dimensional information.

[0016] Alternatively, the synthetic three-dimensional information creation unit may create synthetic three-dimensional image information based on the synthetic three-dimensional information.

[0017] According to the present invention, the measurement information is displayed as an image. This allows the user to make an operation while visually checking the measurement state, and thus improves the operability.

[0018] In an embodiment according to the present invention, in the narrow range three-dimensional measurement information acquisition step, the plurality of pieces of narrow range three-dimensional measurement information may be measured at a higher resolution than that of the wide range three-dimensional measuring information.

[0019] According to the present invention, the resultant synthetic three-dimensional information on the measurement range includes the narrow range three-dimensional measurement information of a high resolution based on the wide range three-dimensional measurement information with no accumulation of errors. Thus, three-dimensional measurement on the entirety of the measurement range is performed at high precision with a high resolution.

[0020] In an embodiment according to the present invention, in the synthetic three-dimensional information creation step, the synthetic three-dimensional information may be created by use of, as intra-measurement range position information, characteristic portion information common to each of the plurality of pieces of narrow range three-dimensional measurement information and the wide range three-dimensional measurement information.

[0021] Alternatively, the synthetic three-dimensional information creation unit may create the synthetic three-dimensional information by use of, as the intra-measurement range position information, characteristic portion information common to the each of plurality of pieces of narrow range three-dimensional measurement information and the wide range three-dimensional measurement information.

[0022] According to the present invention, the plurality of pieces of narrow range three-dimensional measurement information are accurately synthesized based on the wide range three-dimensional measurement information by use of the characteristic portion information to create the synthetic three-dimensional information.

[0023] In an embodiment according to the present invention, the intraoral three-dimensional measuring method may further include a position information acquisition step of acquiring position information on each of the plurality of pieces of narrow range three-dimensional measurement information and acquiring position information on the wide range three-dimensional measurement information. In the synthetic three-dimensional information creation step, the synthetic three-dimensional information may be adjusted based on the position information acquired in the position information acquisition step.

[0024] Alternatively, the intraoral three-dimensional measuring device may further include a position information acquisition unit acquiring position information on each of the plurality of pieces of narrow range three-dimensional measurement information and acquiring position information on the wide range three-dimensional measurement information. The synthetic three-dimensional information creation unit may adjust the synthetic three-dimensional information based on the position information acquired by the position information acquisition unit.

[0025] The position information described above may be position information based on an absolute position at the time of three-dimensional measurement as being acquired by the GPS, or position information based on a relative position with respect to, for example, the intraoral space. Therefore, the position information acquisition unit described above may be a measurement device measuring an absolute position such as a GPS or the like or a measurement device measuring a relative position such as a position sensor or the like. Alternatively, the position information may be acquired by an acceleration sensor, a velocity sensor, a gyro sensor, an azimuthal sensor, a posture sensor, or a combination of any of these sensors.

[0026] According to the present invention, the synthetic three-dimensional information is adjusted based on the position information on each of the plurality of pieces of narrow range three-dimensional measurement information and position information on the wide range three-dimensional measurement information. Therefore, the synthetic three-dimensional information is more precise and more accurate.

[0027] In an embodiment according to the present invention, in the synthetic three-dimensional information creation step, a part of the wide range three-dimensional measurement information corresponding to each piece of narrow range three-dimensional measurement information may be overwritten with the each piece of narrow range three-dimensional measurement information.

[0028] According to the present invention, the information amount of the synthetic three-dimensional information is decreased.

[0029] In an embodiment according to the present invention, the wide range three-dimensional measurement information may be entire measurement information on a shape of the entirety of the measurement range.

[0030] According to the present invention, the resultant synthetic three-dimensional information has no accumulation of errors and is more accurate than synthetic three-dimensional information created in the case where a plurality of pieces of three-dimensional measurement information on ranges narrower than the wide range and wider than the narrow range are joined together at an overlapping portion of each piece of three-dimensional measurement information to provide wide range three-dimensional measurement information on the entirety of the measurement range.

[0031] In an embodiment according to the present invention, the intraoral three-dimensional measuring method may further include an entire joining measurement information creation step of locating a plurality of pieces of the wide range three-dimensional measurement information by use of, as a joining reference, wide range position information common to adjacent pieces of wide range three-dimensional measurement information, to create entire joining measurement information on the entirety of the measurement range.

[0032] According to the present invention, a plurality of pieces of wide range three-dimensional measurement information are located by use of, as the joining reference, wide range position information common to adjacent pieces of wide range three-dimensional measurement information, to create the entire joining measurement information on the entirety of the measurement range. Therefore, the synthetic three-dimensional information is created more accurately even on a wider measurement range.

[0033] In an embodiment according to the present invention, at least one of the plurality of pieces of the narrow range three-dimensional measurement information may be adjustment narrow range three-dimensional measurement information including measurement information on a part corresponding to the wide range position information; and the intraoral three-dimensional measuring method may further include an entire joining measurement information adjustment step of adjusting the entire joining measurement information based on the adjustment narrow range three-dimensional measurement information located in the synthetic three-dimensional information creation step.

[0034] According to the present invention, the entire joining measurement information on the entirety of the measurement range, created by locating the plurality of pieces of the wide range three-dimensional measurement information by use of, as a joining reference, wide range position information common to the adjacent pieces of wide range three-dimensional measurement information, is adjusted based on the adjustment narrow range three-dimensional measurement information. Thus, the entire joining measurement information is adjusted based on clearer characteristic portion information. Therefore, the synthetic three-dimensional information is created more accurately even on a wider measurement range.

[0035] An embodiment according to the present invention is directed to an intraoral three-dimensional measurement result display method for creating images based on the wide range three-dimensional measurement information and the plurality of pieces of narrow range three-dimensional measurement information by the above-described intraoral three-dimensional measuring method and displaying the images in an overlapping manner.

[0036] According to the present invention, the synthetic three-dimensional image is created while a state where the narrow range three-dimensional image is overlapped on the wide range three-dimensional image is displayed. Therefore, the user performs the synthesis operation while visually checking the synthesis state, and thus the synthetic three-dimensional information is created more accurately.

[0037] In an embodiment according to the present invention, the wide range three-dimensional measurement information and the plurality of pieces of narrow range three-dimensional measurement information displayed as the images in an overlapping manner may be displayed with at least one of brightness, color, luminance and display pattern being different between the images.

[0038] According to the present invention, the user clearly recognizes the narrow range three-dimensional image against the wide range three-dimensional image. Therefore, the synthetic three-dimensional information is created more accurately.

[0039] In an embodiment according to the present invention, the measurement information acquisition unit may include a three-dimensional measurement element including a light source emitting projection light toward a measurement target; an image capturing element capturing an image of an area irradiated with the projection light; a guide path guiding light reflected by the measurement target toward the image capturing element; and a handheld housing accommodating the light source, the guide path and the image capturing element.

[0040] The light source described above may be any of various light sources including a planar light source having a planar light emitting portion, a point light source having a point-like light emitting portion, and a strip light source having a strip-like light emitting portion. The light source may be a single light source or an array light source including a plurality of light sources. The light source may emit light that is shaped by a lens, an optical fiber, a light diffuser, a mask or the like. The light source may be a uniform light source emitting uniform projection light or a structured light source emitting structured light having a sine waveform-like pattern, a lattice pattern or the like, or may include both of the uniform light source and the structured light source. The structured light source may include a mechanism dynamically changing the pattern of the structured projection light. The light source maybe located such that the projection light passes the guide path or is directed directly toward the measurement target without passing the guide path.

[0041] In the case where a stereo method by use of a multiview camera is used as the three-dimensional measuring method, a plurality of image capturing units may be used. In the case where any other method is used as the three-dimensional measuring method, a single image capturing unit may be used. The image capturing unit may be a CCD (Charge Coupled Device) image sensor using a photodiode, a CMOS (Complementary MOS) image sensor, or the like.

[0042] According to the present invention, three-dimensional on the measurement range in the narrow intraoral space is performed at high precision.

[0043] In an embodiment according to the present invention, the guide path may include a wide range guide path usable to measure the wide range; a narrow range guide path usable to measure the narrow range; and a switching unit switching the guide path to the wide range guide path or to the narrow range guide path.

[0044] According to the present invention, one three-dimensional measurement element is usable to perform three-dimensional measurement on the entirety of the measurement range at high precision by merely switching the measurement range to the wide measurement range or to the narrow measurement range with a simple structure.

[0045] In an embodiment according to the present invention, a part of the housing may include an exchangeable unit that includes at least the guide path and is detachable and exchangeable to change the measurement range.

[0046] According to the present invention, one three-dimensional measurement element is usable to perform three-dimensional measurement on the entirety of the measurement range at high precision by merely switching the exchangeable unit to switch the measurement range to the wide measurement range or to the narrow measurement range.

[0047] Preferably, the attachment error detection unit detecting an attachment error for the exchangeable unit, and the measurement result correction unit correcting the measurement result based on the attachment error, are further provided.

[0048] In an embodiment according to the present invention, the intraoral three-dimensional measuring device may further include an attachment that includes at least the guide path and is detachable from the housing to change the measurement range.

[0049] According to the present invention, one three-dimensional measurement element is usable to perform three-dimensional measurement on the entirety of the measurement range at high precision by merely detaching or attaching the attachment to switch the measurement range to the wide measurement range or to the narrow measurement range.

[0050] Preferably, the attachment error detection unit detecting an attachment error for the attachment, and the measurement result correction unit correcting the measurement result based on the attachment error, are further provided.

[Effect of the Invention]

[0051] The present invention provides an intraoral three-dimensional measuring device and an intraoral three-dimensional measuring method capable of accurately performing three-dimensional measurement on a wide measurement range in an intraoral space, which is narrow, and also provides an intraoral three-dimensional measurement result display method.

BRIEF DESCRIPTION OF DRAWINGS

[0052]

FIG. 1 is a schematic structural view of an intraoral three-dimensional measuring device.

FIG. 2 is a schematic structural view of a handy scanner in an embodiment.

FIG. 3 is a flowchart showing an intraoral three-dimensional measuring method in an embodiment.

FIG. 4 shows the intraoral three-dimensional measuring method.

FIG. 5 is a schematic structural view of a handy scanner in another embodiment.

FIG. 6 is a schematic structural view of a handy scanner in still another embodiment.

FIG. 7 is a schematic structural view of a handy scanner in still another embodiment.

FIG. 8 is a flowchart showing an intraoral three-dimensional measuring method in another embodiment.

FIG. 9 is a flowchart showing an intraoral three-dimensional measuring method in still another embodiment.

FIG. 10 is a schematic view showing an intraoral three-dimensional measurement result display method.

FIG. 11 shows a conventional intraoral three-dimensional measuring method.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0053] Hereinafter, an intraoral three-dimensional measuring device 1 according to the present invention will be described with reference to FIG. 1 through FIG. 4.

[0054] FIG. 1 is a schematic view of an intraoral three-dimensional measuring device 1. FIG. 2 is a schematic structural view of a handy scanner 10 (corresponding to a three-dimensional measuring element). FIG. 3 is a flowchart showing an intraoral three-dimensional measuring method. FIG. 4 shows the intraoral three-dimensional measuring method.

[0055] In more detail, FIG. 4(a) is an isometric view of a wide range three-dimensional measuring state, FIG. 4(b) is an isometric view of a narrow range three-dimensional measuring state, FIG. 4(c) shows a wide range three-dimensional image Iw (corresponding to wide range three-dimensional image information), FIG. 4(d) shows a state where narrow range three-dimensional images In (corresponding to narrow range three-dimensional image information) are overlapped on the wide range three-dimensional image Iw, and FIG. 4 (e) shows a synthetic three-dimensional image Ic (corresponding to synthetic three-dimensional image information).

[0056] As shown in FIG. 1, the intraoral three-dimensional measuring device 1 is for measuring a three-dimensional shape of an intraoral dental arch Da, and includes a handy scanner 10, a control unit 20 and a monitor 30. The handy scanner 10 and the monitor 30 are connected with the control unit 20.

[0057] The handy scanner 10 includes a handheld housing main body 110 and a tip unit 120 (120a, 120b) (corresponding to an exchangeable unit) detachable from the housing main body 110.

[0058] The housing main body 110 accommodates a light source 111, a pattern generation unit 112, and an image capturing unit 113 (corresponding to an image capturing element). The pattern generation unit 112 converts projection light Lt, emitted from the light source 111 toward a tooth T as a measurement target, into structured light having a desirable pattern. The image capturing unit 113 captures an image of an area irradiated with the projection light Lt. The housing main body 110 is connected with the control unit 20 described below, and the light source 111, the pattern generation unit 112 and the image capturing unit 113 are controlled by a control/computation device 21 included in the control unit 20.

[0059] In this example, the pattern generation unit 112 is, for example, a slit mask including light transmissive portions and light blocking portions provided alternately in a periodical manner. After passing the pattern generation unit 112, the projection light Lt emitted by the light source 111 has a sinewave pattern. A combination of the light source 111 and the pattern generation unit 112 may be considered as a light source for structured light.

[0060] The light source 111 may be any of various light sources including a planar light source having a planar light emitting portion, a point light source having a point-like light emitting portion, and a strip light source having a strip-like light emitting portion. The light source 111 maybe a single light source or an array light source including a plurality of light sources. The light source 111 may emit light that is shaped by a lens, an optical fiber, a light diffuser, a mask or the like.

[0061] In the case where the three-dimensional measuring method used by the intraoral three-dimensional measuring device 1 is a stereo method by use of a multiview camera, a plurality of image capturing units 113 are used. In the case where the three-dimensional measuring method used by the intraoral three-dimensional measuring device 1 is any other method, a single image capturing unit 113 is used. In this example, the intraoral three-dimensional measuring device 1 uses a phase shift method, and a single image capturing unit 113 is used.

[0062] The image capturing unit 113 may be a CCD (Charge Coupled Device) image sensor using a photodiode, a CMOS (Complementary MOS) image sensor, or the like. In FIG. 2, a light input/output opening 121 is on a bottom and tip side. Alternatively, the light input/output opening 121 may be at any side.

[0063] The tip unit 120 is detachable from a tip of the housing main body 110. The tip unit 120 includes a guide path 130. The guide path 130 guides the projection light Lt emitted from the light source 111 toward the tooth T or the like as the measurement target and also guides reflected light Lr reflected by the tooth T or the like. The tip unit 120 also includes the light input/output opening 121 at a bottom surface on the tip side. Via the light input/output opening 121, the projection light Lt is output toward the tooth T, and the reflected light Lr reflected by the tooth T is incident on the tip unit 120.

[0064] The guide path 130 includes a projection light path 131 usable to guide the projection light Lt and a reflected light path 132 usable to guide the reflected light Lr.

[0065] There are two types of tip unit 120. One is a wide range tip unit 120a usable to measure a wide range, and the other is a narrow range tip unit 120b usable to measure a range narrower than the wide range. The wide range tip unit 120a and the narrow range tip unit 120b are attachable to the housing main body 110 in an exchangeable manner.

[0066] The wide range tip unit 120a and the narrow unit tip unit 120b include different types of guide path 130. The wide range tip unit 120a includes a wide range guide path 130a usable to measure a wide range, and the narrow unit tip unit 120b includes a narrow range guide path 130b usable to measure a narrow range.

[0067] The wide range guide path 130a includes a wide range projection light path 131a and a wide range reflected light path 132a. The narrow range guide path 130b includes a narrow range projection light path 131b and a narrow range reflected light path 132b. The size of range to be measured may be adjusted by appropriately designing the positions, the focal distances and the number of lenses or any other optical element built in the guide path 130 of the tip unit 120.

[0068] The control unit 20 connected with the handy scanner 10 and the monitor 30 includes the control/computation device 21, and a storage unit 22.

[0069] The control/computation device 21 controls the light emission of the light source 111, a dynamic change in the pattern of the structured light to be projected (e.g., a shift in the phase of the structured light when the phase shift method is used, or a change in the focal position of the structured light when the focus method is used), or the image capturing of the image capturing unit 113. The control/computation device 21 also computes a three-dimensional shape based on the result of image capturing performed by the image capturing unit 113 to generate a three-dimensional measurement image. The storage unit 22 is connected with the control/computation device 21 and stores a control program or the like usable to control various data or devices connected thereto.

[0070] The monitor 30 is a display device such as a liquid crystal display device or the like, and is connected with the control unit 20. The monitor 30 is controlled by the control unit 20 to display a three-dimensional measurement image I or the like.

[0071] In FIG. 1, the control unit 20 and the handy scanner 10 have different housings. In the case where the entirety of, or a part of, the control unit 20 is sufficiently small, the control unit 20 may be accommodated in the housing main body 110 of the handy scanner 10.

[0072] The intraoral three-dimensional measuring device 1 having such a structure is used to accurately perform three-dimensional measurement on a wide measurement range in the narrow intraoral space by the intraoral three-dimensional measuring method. Hereinafter, the intraoral three-dimensional measuring method will be described with reference to FIG. 3 and FIG. 4.

[0073] In the following description, three-dimensional measurement will be performed on the entirety of the dental arch Da as the wide measurement range in the narrow intraoral space.

[0074] In this case, the wide range tip unit 120a including the wide range guide path 130a is attached to the housing main body 110 of the handy scanner 10. First, as shown in FIG. 4(a), a wide range Rw including the entirety of the dental arch Da is subjected to three-dimensional measurement by the handy scanner 10 to acquire wide range three-dimensional measurement information (step s1 in FIG. 3). Based on the acquired wide range three-dimensional measurement information, the control/computation device 21 creates a wide range three-dimensional image Iw (FIG. 4(c)). The wide range three-dimensional image Iw is displayed on the monitor 30.

[0075] The wide range three-dimensional measurement information is acquired by the handy scanner 10 including the wide range tip unit 120a including the wide range guide path 130a and is on the entirety of the wide range Rw. Therefore, the information is of a low resolution, and the wide range three-dimensional image Iw created based on this information is also of a low resolution. The wide range three-dimensional image Iw often misses three-dimensional information of dead angles and thus is incomplete. In FIG. 4(c), FIG. 4(d) and FIG. 4(e), an image of a low resolution is represented by the dashed line, and an image of a high resolution described below is represented by the solid line.

[0076] Next, as shown in FIG. 4(b), the narrow range tip unit 120b including the narrow range guide path 130b is attached to the housing main body 110 of the handy scanner 10 in replacement of the wide range tip unit 120a. A narrow range Rn including a small number of teeth T of the dental arch Da is subjected to three-dimensional measurement by the handy scanner 10 to acquire narrow range three-dimensional measurement information (step s2) . Based on the acquired narrow range three-dimensional measurement information, the control/computation device 21 creates a narrow range three-dimensional image In.

[0077] The narrow range three-dimensional measurement information is acquired by the handy scanner 10 including the narrow range tip unit 130a including the narrow range guide path 130b and is on the narrow range Rn narrower than the wide range Rw. Therefore, the information is of a high resolution, and the narrow range three-dimensional image In created based on this information is also of a high resolution.

[0078] The narrow range three-dimensional image In created by the control/computation device 21 is displayed on the monitor 30 together with the wide range three-dimensional image Iw. More specifically, as shown in FIG. 4(d), an overlapping process is performed (step s3). In the overlapping step, the narrow range three-dimensional image In of a high resolution is overlapped on the wide range three-dimensional image Iw of a low resolution to create a synthetic three-dimensional image Ic.

[0079] In more detail, the overlapping process is as follows. Information on a characteristic portion (such information will be referred to as "characteristic portion information") included in the narrow range three-dimensional measurement information displayed as the narrow range three-dimensional image In, and information on a characteristic portion included in the wide range three-dimensional measurement information displayed as the wide range three-dimensional image Iw are compared against each other, and common characteristic portion information (corresponding to intra-measurement range position information) is extracted. By use of such common characteristic portion information, the narrow range three-dimensional measurement information of a high resolution (narrow range three-dimensional image In) is overlapped on the wide range three-dimensional measurement information of a low resolution (wide range three-dimensional image Iw).

[0080] Such an overlapping process of overlapping the narrow range three-dimensional image In of a high resolution on the wide range three-dimensional image Iw of a low resolution to create the synthetic three-dimensional image Ic (step s3) is performed a plurality of times in repetition while the number of repetition has not reached a predetermined number of times (step s4: No) until the entirety of the dental arch Da is covered.

[0081] In the overlapping process shown in FIG. 4(d), a plurality of narrow range three-dimensional images In of right back portions of the dental arch Da are overlapped on the wide range three-dimensional image Iw of the entirety of the dental arch Da.

[0082] When the overlapping process of overlapping the narrow range three-dimensional image In on the wide range three-dimensional image Iw is performed the predetermine number of times, namely, when the plurality of narrow range three-dimensional images In are overlapped on the entirety of the wide range three-dimensional image Iw (step s4: Yes), information on each of parts of the wide range three-dimensional image Iw is overwritten with the corresponding narrow range three-dimensional image In. Thus, the synthetic three-dimensional image Ic is created (step s5).

[0083] The handy scanner 10 may include a position information acquisition unit 40 such as a GPS or the like acquiring position information on the three-dimensional measurement information (wide range three-dimensional measurement information, narrow range three-dimensional measurement information) to be acquired. In this case, based on the acquired position information (position information acquisition step), synthetic three-dimensional information (synthetic three-dimensional image Ic) in which the position of each piece of narrow range three-dimensional measurement information (narrow range three-dimensional image In) is adjusted with respect to the wide range three-dimensional measurement information (wide range three-dimensional image Iw) is created.

[0084] In the above description, the wide range tip unit 120a or the narrow range tip unit 120b is attached to the housing main body 110 in an exchangeable manner. The hand scanner 10 may include an attachment error detection unit 50 (FIG. 1) detecting an attachment error d (FIG. 2) between the tip unit 120 and the housing main body 110 at the time of exchange. In this case, the control unit 20 may include a measurement result correction unit 23 (FIG. 1) correcting a three-dimensional measurement result based on the attachment error d detected by the attachment error detection unit 50.

[0085] In the above description, the wide range tip unit 120a or the narrow range tip unit 120b is attached to the housing main body 110 in an exchangeable manner. Alternatively, as shown in FIG. 5, an attachment 120c including an additional guide path 130c may be attached to the wide range tip unit 120a, so that a combination of the wide range tip unit 120a and the attachment 120c is used instead of the narrow range tip unit 120b.

[0086] In FIG. 5, the attachment 120c includes the light input/output opening 121 at the bottom surface on the tip side, like the tip unit 120. Alternatively, the light input/output opening 121 may be at any side. The additional guide path 130c includes an additional projection light path 131c and an additional reflected light path 132c, like the wide range guide path 130a.

[0087] In FIG. 5, a combination of the wide range tip unit 120a and the attachment 120c is used in place of the narrow range tip unit 120b. Alternatively, a combination of the narrow range tip unit 120b and an attachment may be used in place of the wide range tip unit 120a. The size of range to be measured may be adjusted by appropriately designing the positions, the focal distances and the number of lenses or any other optical element built in the guide paths in the tip unit and the attachment.

[0088] The attachment 120c may include an attachment error detection unit detecting an attachment error d' (FIG. 5) between the wide range tip unit 120a and the attachment 120c. In this case also, the control unit 20 may include a measurement result correction unit 23 correcting a three-dimensional measurement result based on the attachment error d' detected by the attachment error detection unit 50.

[0089] As shown in FIG. 6, a tip unit 120d may be attached to the housing main body 110. The tip unit 120d includes the wide range guide path 130a, the narrow range guide path 130b, and an optical path switching unit 60 switching the optical path. The optical path switching unit 60 is, for example, a mirror. In this case, the control unit 20 may include a switch control unit 24 (FIG. 1) controlling the optical path switching unit 60 to switch the optical path.

[0090] In the example shown in FIG. 6, the tip unit 120d includes the wide range guide path 130a and the narrow range guide path 130b located side by side, and the optical path is switched by the optical path switching unit 60. Alternatively, the tip unit 120d may include the wide range guide path 130a and the additional guide path 130c included in the attachment 120c coupled with each other in series. In this case, the optical switching unit 60 switches between a state where the light is guided by the additional guide path 130c and a state where the light is not guided by the additional guide path 130c. The size of range to be measured may be adjusted by appropriately selecting the positions, the focal distances and the number of lenses or any other optical element built in the guide path 130 by the switching operation.

[0091] As shown in FIG. 7, the handy scanner 10 may include a tip unit 120e including a range adjustment guide path 130e (including a range adjustment projection light path 131e and a range adjustment reflected light path 132e) . The range adjustment guide path 130e adjusts the measurement range from the wide range to the narrow range by, for example, using a focal distance adjusting optical element such as a variable-focus lens (e.g., liquid lens), a spatial light modulator, a deformable mirror or the like, or mechanically moving a lens or the like included in the guide path.

[0092] In the above description, after all the narrow range three-dimensional images In are overlapped on the wide range three-dimensional images Iw (step s4: Yes), the information on each part of the wide range three-dimensional image Iw is overwritten with the corresponding narrow range three-dimensional image In (step s5). Alternatively, after each narrow range three-dimensional image In is overlapped on the wide range three-dimensional image Iw (step s3), the information on the corresponding part of the wide range three-dimensional image Iw may be overwritten with the narrow range three-dimensional image In.

[0093] In the above description, the wide range Rw including the entirety of the dental arch Da is subjected to three-dimensional measurement to acquire the wide range three-dimensional measurement information, and the wide range three-dimensional image Iw is created based on the wide range three-dimensional measurement information. Alternatively, the dental arch Da may be divided into a plurality of wide ranges, which are subjected to three-dimensional measurement.

[0094] In this case, the measurement is performed as shown in FIG. 8. The wide range tip unit 120a including the wide range guide path 130a is attached to the housing main body 110 of the handy scanner 10. A wide range including a part of the dental arch Da is subjected to three-dimensional measurement by the handy scanner 10 to acquire wide range three-dimensional measurement information (step t1).

[0095] Such a step is performed in repetition while the number of repetition has not reached a predetermined number of times (step t2: No). As a result of the step being repeated the predetermined number of times (step t2: Yes), the wide range three-dimensional measurement information on the entirety of the dental arch Da is acquired. For this step, a plurality of wide ranges are set so as to cover the entirety of the dental arch Da and so as to include overlap portions Rr.

[0096] Such a wide range Rr is a part of the dental arch Da but is wider than the narrow range Rn. Therefore, the number of times by which such a wide range is subjected to three-dimensional measurement to measure the entirety of the dental arch Da is smaller than the number of times by which the narrow range Rn is subjected to three-dimensional measurement to measure the entirety of the dental arch Da.

[0097] Then, the acquired plurality of pieces of wide range three-dimensional measurement information are joined together by use of, as a joining reference, three-dimensional measurement information on the overlap portions Rr (step t3). As a result, entire joining measurement information on the entirety of the dental arch Da is created.

[0098] Based on the entire joining measurement information, the control/computation device 21 creates a wide range three-dimensional image Iw. In the meantime, a narrow range Rn is subjected to three-dimensional measurement to acquire narrow range three-dimensional measurement information. Based on the acquired narrow range three-dimensional measurement information, the control/computation device 21 creates a narrow range three-dimensional image In (step t4). Then, an overlapping process is performed (step t5); more specifically, the narrow range three-dimensional image In is overlapped on the wide range three-dimensional image Iw to create a synthetic three-dimensional image Ic. Such an overlapping process is performed in repetition while the number of repetition has not reached a predetermined number of times (step t6: No).

[0099] When the overlapping process of overlapping the narrow range three-dimensional image In on the wide range three-dimensional image Iw is performed the predetermined number of times, namely, when the plurality of narrow range three-dimensional images In are overlapped on the entirety of the wide range three-dimensional image Iw (step t6: Yes), the information on each of parts of the wide range three-dimensional image Iw is overwritten with the corresponding narrow range three-dimensional image In. Thus, the synthetic three-dimensional image Ic is created (step t7).

[0100] In the step of joining the plurality of pieces of wide range three-dimensional measurement information to create the entire joining measurement information and creating the wide range three-dimensional image Iw based on the entire joining measurement information, the entire joining measurement information may be adjusted based on narrow range three-dimensional measurement information including information on parts corresponding to the overlap portions Rr. The information on such parts is usable as the joining reference.

[0101] In this case, the measurement is performed as shown in FIG. 9. First, steps u1 through u3 corresponding to step t1 through t3 in FIG. 8 are performed to create entire joining measurement information on the entirety of the dental arch Da.

[0102] Then, the narrow range tip unit 120b including the narrow range light path 130b is attached to the housing main body 110 of the handy scanner 10. A narrow range Rn including a plurality of teeth T of the dental arch Da is subjected to three-dimensional measurement by the handy scanner 10 to acquire narrow range three-dimensional measurement information (step u4). In the case where acquired narrow range three-dimensional measurement information includes measurement information on a part corresponding to an overlap portion Rr, usable as the joining reference (step u5: Yes), it is determined whether or not the joining of the corresponding parts of the wide range three-dimensional measurement information is to be adjusted based on the narrow range three-dimensional measurement information (corresponding to adjustment narrow range three-dimensional measurement information) including the measurement information on the part corresponding to the overlap portion Rr. When it is determined to perform adjustment (step u6: Yes), the adjustment is performed, and thus post-adjustment entire joining measurement information is created (step u7). The narrow range three-dimensional measurement information is overlapped on the post-adjustment entire joining measurement information to create synthetic three-dimensional information (step u8).

[0103] In the case where the acquired narrow range three-dimensional measurement information does not include measurement information on the part corresponding to the overlap portion Rr (step u5: No), or it is determined that the joining of the corresponding parts of the wide range three-dimensional measurement information is not to be adjusted (step u6: No), the narrow range three-dimensional measurement information is overlapped on the entire joining measurement information (step u8) . Such an operation is performed in repetition while the number of repetition has not reached a predetermined number of times (step u9: No). When the narrow range three-dimensional measurement information is overlapped on the entirety of the entire joining measurement information (step u9: Yes), the entire joining measurement information is overwritten with the narrow range three-dimensional measurement information to create a synthetic three-dimensional image Ic (step u10).

[0104] There may be an operation mode in which even if the condition for terminating the repetition in each of steps s4, t2, t6, u2 and u9, the user terminates the measurement by pressing a termination button or the like to create the three-dimensional image Ic or Iw although being incomplete.

[0105] There may be an operation mode by which the user resumes the measurement from the middle of the repetition in each of steps s4, t2, t6, u2 and u9 by pressing a resume switch or the like.

[0106] In the above description, the narrow range three-dimensional image In of a high resolution is overlapped on the wide range three-dimensional image Iw of a low resolution. Alternatively, as shown in FIG. 10, for example, the wide range three-dimensional image Iw of a low resolution may be displayed at a low brightness, or the narrow range three-dimensional image In of a high resolution may be displayed at a high brightness. The wide range three-dimensional image Iw and the narrow range three-dimensional image In may be displayed with color, luminance or display pattern (e.g., in a continuously lit up state, or a blinked state) being different between the images. Needless to say, the brightness, color, luminance, display pattern and any other manner of display may be varied in combination.

[0107] In the above description, the measurement target is the entirety of the dental arch Da. Alternatively, the measurement target may be, for example, a part of the dental arch Da.

[0108] As described above, the intraoral three-dimensional measuring device 1 is used to perform a wide range three-dimensional measurement information acquisition step (step s1, t1, u1), a narrow range three-dimensional measurement information acquisition step (step s2, t4, u4), and a synthetic three-dimensional information creation step (step s3, t5, u8). In the wide range three-dimensional measurement information acquisition step, a three-dimensional shape of the wide range Rw including the dental arch Da, which is a desirable measurement range in an intraoral space, is measured to acquire wide range three-dimensional measurement information. In the narrow range three-dimensional measurement information acquisition step, three-dimensional shapes of the narrow ranges Rn, which are narrower than the wide range Rw, are measured to acquire a plurality of pieces of narrow range three-dimensional measurement information. In the synthetic three-dimensional information creation step, the plurality of pieces of narrow range three-dimensional measurement information are located based on the wide range three-dimensional measurement information to create synthetic three-dimensional information on the measurement range. In this step, each piece of narrow range three-dimensional measurement information is located by use of, as a synthesis reference, intra-measurement range position information (characteristic portion information) common to the wide range three-dimensional measurement information and the narrow range three-dimensional measurement information. The synthetic three-dimensional information on the measurement range created in this manner includes the narrow range three-dimensional measurement information based on the wide range three-dimensional measurement information. The accumulation of errors, which is a problem of the conventional measuring device Z, is not caused. Thus, three-dimensional measurement on the dental arch Da, which is a wide measurement range in the narrow intraoral space, is accurately performed.

[0109] The wide range three-dimensional measurement information acquired by measurement on the three-dimensional shape of the wide range Rw is used to create the wide range three-dimensional image Iw. The narrow range three-dimensional measurement information acquired by measurement on the three-dimensional shape of the narrow range Rn is used to create the narrow range three-dimensional images In. In the synthetic three-dimensional information creation step (step s3, t5, u8), the synthetic three-dimensional image Ic is created based on the synthetic three-dimensional information. In this manner, the measurement information on the entirety of the measurement range is displayed as an image. This allows the user to make an operation while visually checking the measurement results, and thus improves the operability.

[0110] In the narrow range three-dimensional measurement information acquisition step (step s2, t4, u4), the narrow range three-dimensional measurement information is acquired at a higher resolution than that of the wide range three-dimensional measurement information. Therefore, the resultant synthetic three-dimensional information (synthetic three-dimensional image Ic) of the measurement range includes the narrow range three-dimensional measurement information of a high resolution based on the wide range three-dimensional measurement information with no accumulation of errors. Thus, three-dimensional measurement on the entirety of the measurement range is performed at a high resolution.

[0111] When the narrow range three-dimensional measurement information (narrow range three-dimensional image In) is located on the wide range three-dimensional measurement information (wide range three-dimensional image Iw), the part of the wide range three-dimensional measurement information corresponding to the narrow range three-dimensional measurement information is overwritten with the narrow range three-dimensional measurement information (step s5, t7, u10). Therefore, the information amount of the synthetic three-dimensional information is decreased.

[0112] The wide range three-dimensional measurement information is acquired by measurement on the shape of the entirety of the dental arch Da. The resultant synthetic three-dimensional information is more accurate than synthetic three-dimensional information created in the case where a plurality of pieces of information on ranges narrower than the wide range Rw and wider than the narrow range Rn are joined together at overlapping portions to provide wide range three-dimensional measurement information on the entirety of the measurement range.

[0113] The wide range three-dimensional image Iw (wide range three-dimensional measurement information) and the narrow range three-dimensional image In (narrow range three-dimensional measurement information) both created by the above-described intraoral three-dimensional measuring method may be displayed on the monitor 30 in an overlapping manner. In this case, the synthetic three-dimensional image Ic is created while a state where the narrow range three-dimensional image In is overlapped on the wide range three-dimensional image Iw is displayed. Therefore, the synthesis operation is performed while the synthesis state is visually checked, and thus the synthetic three-dimensional information is created more accurately.

[0114] The handy scanner 10 includes the light source 111; the pattern generation unit 112 converting the projection light Lt, emitted from the light source 111 toward the tooth T as a measurement target, into structured light having a desirable pattern; the guide path 130 (130a, 130b, 130c, 130e) guiding the projection light Lt emitted from the light source 111 toward the dental arch Da and also guiding the reflected light Lr reflected by the dental arch Da; the image capturing unit 113 capturing an area irradiated with the projection light Lt; and the handheld housing main body 110 accommodating the light source 111, the pattern generation unit 112 and the image capturing unit 113. Therefore, three-dimensional measurement on a measurement range in the narrow intraoral space is performed at high precision.

[0115] The handy scanner 10 may use the wide range tip unit 120a or the narrow range tip unit 120b in an exchangeable manner to change the measurement range. The wide range tip unit 120a and the narrow range tip unit 120b are detachable from the housing main body 110. In this case, the measurement range is switched to the wide measurement range or to the narrow measurement range by merely exchanging the tip unit 120. One handy scanner 10 is usable to perform three-dimensional measurement on the entirety of the measurement range at high precision.

[0116] Preferably, the attachment error detection unit 50 detecting an attachment error d between the tip unit 120a or 120b and the housing main body 110, and the measurement result correction unit 23 correcting the measurement result based on the attachment error d, are further provided.

[0117] As shown in FIG. 5, the handy scanner 10 may use the attachment 120c. The attachment 120c includes the additional guide path 130c and is attachable to the wide range tip unit 120a, attached to the housing main body 110, to change the measurement range. In this case, the measurement range is switched to the wide measurement range or the narrow measurement range by merely attaching or detaching the attachment 120c. One handy scanner 10 is usable to perform three-dimensional measurement on the entirety of the measurement range at high precision.

[0118] Preferably, the attachment error detection unit 50 detecting an attachment error d' between the attachment 120c and the housing main body 110, and the measurement result correction unit 23 correcting the measurement result based on the attachment error d', are further provided.

[0119] As shown in FIG. 6, the handy scanner 10 may use the tip unit 120d including the optical path switching unit 60 switching the guide path to the wide range guide path 130a usable to measure the wide range or to the narrow range guide path 130b usable to measure the narrow range. Inthiscase, one handy scanner 10 is usable to perform three-dimensional measurement on the entirety of the measurement range at high precision by merely switching the measurement range to the wide measurement range or to the narrow measurement range with a simple structure.

[0120] The handy scanner 10 may include the position information acquisition unit 40, so that the position information acquisition step is performed. In the position information acquisition step, the position information on each of the narrow range three-dimensional measurement information and the wide range three-dimensional measurement information is acquired. In the synthetic three-dimensional information creation step (step s3, t5, u8), the synthetic three-dimensional information is adjusted based on the position information acquired in the position information acquisition step. The resultant synthetic three-dimensional information is more precise and more accurate.

[0121] As shown in FIG. 8, an entire joining measurement information creation step (step t3, u3) may be performed. In the entire joining measurement information creation step, a plurality of pieces of wide range three-dimensional measurement information are located by use of, as the joining reference, wide range position information common to adjacent pieces of wide range three-dimensional measurement information, to create the entire joining measurement information on the entirety of the measurement range. In this case, the synthetic three-dimensional information is created more accurately even on a wider measurement range.

[0122] As shown in FIG. 9, at least one of the plurality of narrow range three-dimensional measurement information is used as narrow range three-dimensional measurement information (adjustment narrow range three-dimensional measurement information) including information on the part corresponding to the overlap portion Rr, which is usable as the joining reference. Before the synthetic three-dimensional information creation step (step s3, t5, u8), an entire joining measurement information adjustment step (step u7) may be performed. In the entire joining measurement information adjustment step, the entire joining measurement information is adjusted based on the narrow range three-dimensional measurement information (adjustment narrow range three-dimensional measurement information) . In this case, the entire joining measurement information is adjusted based on clearer characteristic portion information. Therefore, the synthetic three-dimensional information is created more accurately even on a wider measurement range.

[0123] As shown in FIG. 10, the wide range three-dimensional image Iw and the narrow range three-dimensional image In may be displayed on the monitor 30 in an overlapping manner with at least one of brightness, color, luminance and display pattern being different between the two types of images. In this case, the narrow range three-dimensional image In is clearly recognizable against the wide range three-dimensional image Iw. Therefore, the synthetic three-dimensional information is created more accurately.

[0124] The wide range three-dimensional measurement information acquisition step according to the present invention corresponds to step s1, t1 or u1 in the above-described embodiment. Similarly,

the narrow range three-dimensional measurement information acquisition step corresponds to step s2, t4 or u4;
the synthetic three-dimensional information creation step corresponds to step s3, t5 or u8;
the wide range three-dimensional image information corresponds to the wide range three-dimensional image Iw;
the narrow range three-dimensional image information corresponds to the narrow range three-dimensional image In;
the synthetic three-dimensional image information corresponds to the synthetic three-dimensional image Ic;
the overwriting process corresponds to step s5, t7 or u10;
the entire joining measurement information creation step corresponds to step t3 or u3;
the adjustment narrow range three-dimensional measurement information corresponds to the narrow range three-dimensional measurement information including information on a part corresponding to the overlap portion Rr;

the entire joining measurement information adjustment step corresponds to step u7;
the measurement information acquisition unit and the three-dimensional measuring element each correspond to the handy scanner 10;
the synthetic three-dimensional information creation unit corresponds to the control/computation device 21;
the position information acquisition unit corresponds to the position information acquisition unit 40;
the measurement target corresponds to the dental arch Da;
the guide path corresponds to the guide path 130, the wide range guide path 130a, the narrow range guide path 130b, the additional guide path 130c, or the range adjustment guide path 130e;
the image capturing element corresponds to the image capturing unit 113;
the wide range guide path corresponds to the wide range guide path 130a;
the narrow range guide path corresponds to the narrow range guide path 130b;
the switching unit corresponds to the optical path switching unit 60; and
the exchangeable unit corresponds to the wide range tip unit 120a or the narrow range tip unit 120b.

[0125] The present invention is not limited to the above-described embodiment, and may be carried out in any of many various embodiments.

[0126] For example, in the above description, the desirable measurement range is the dental arch Da. Alternatively, the desirable measurement range may be a part of the dental arch Da, or the entirety of, or a part of, edentulous jaw.

[0127] The above-described position information is not limited to being acquired by the position information acquisition unit 40 such as a GPS or the like, and may be acquired by a position sensor measuring a relative position with respect to the intraoral space. Alternatively, the position information may be acquired by an acceleration sensor, a velocity sensor, a gyro sensor, an azimuthal sensor, a posture sensor, or a combination of any of these sensors.

[0128] The handy scanner 10 may include a light source for illumination instead of, or in addition to, the light source 111.

[0129] In the above description, in the state where the narrow range three-dimensional measurement information (narrow range three-dimensional image In) is overlapped on the wide range three-dimensional measurement information (wide range three-dimensional image Iw), the part of the wide range three-dimensional measurement information corresponding to the narrow range three-dimensional measurement information is overwritten with the narrow range three-dimensional measurement information (step s5, t7, u10). Alternatively, the narrow range three-dimensional measurement information may be merely overlapped on the wide range three-dimensional measurement information, but the wide range three-dimensional measurement information does not need to be overwritten with the narrow range three-dimensional measurement information.

[Description of the Reference Numerals]

[0130]

1	Intraoral three-dimensional measuring device
10	Handy scanner
21	Control/computation device
40	Position information acquisition unit
60	Optical path switching unit
110	Housing main body
111	Light source
112	Pattern generation unit
113	Image capturing unit
120, 120d, 120e	Tip unit
120a	Wide range tip unit
120b	Narrow range tip unit
120c	Attachment
130	Guide path
130a	Wide range guide path
130b	Narrow range guide path
130c	Additional guide path
130e	Range adjustment guide path
Da	Dental arch
Ic	Synthetic three-dimensional image
In	Narrow range three-dimensional image
Iw	Wide range three-dimensional image
Lr	Reflected light
Lt	Projection light

Claims

1. An intraoral three-dimensional measuring method, comprising:

   a wide range three-dimensional measurement information acquisition step (s1, t1, u1) of acquiring wide range three-dimensional measurement information (Iw) on a three-dimensional shape measured on a wide range (Rw) in a desirable measurement range in an intraoral space;
   a narrow range three-dimensional measurement information acquisition step (s2, t4, u4) of acquiring a plurality of pieces of narrow range three-dimensional measurement information (In) each on a three-dimensional shape measured on a narrow range (Rn) narrower than the wide range (Rw) in the measurement range; and
   a synthetic three-dimensional information creation step (s3, t5, u8) of repeatedly locating each

of the plurality of pieces of narrow range three-dimensional measurement information at its respective position based on the wide range three-dimensional measurement information (In) by use of, as a synthesis reference, intra-measurement range position information common to the wide range three-dimensional measurement information (Iw) and each of the plurality of pieces of narrow range three-dimensional measurement information (In), to create synthetic three-dimensional information on the measurement range.

2. An intraoral three-dimensional measuring method according to claim 1,
the wide range three-dimensional measurement information being used to create wide range three-dimensional image information (Iw) on the three-dimensional shape of the wide range (Rw);
the plurality of pieces of narrow range three-dimensional measurement information each being used to create narrow range three-dimensional image information (In) on the three-dimensional shape of the narrow range (Rn); and
in the synthetic three-dimensional information creation step, synthetic three-dimensional image information (Ic) being created based on the synthetic three-dimensional information.

3. An intraoral three-dimensional measuring method according to claim 1 or 2, wherein in the narrow range three-dimensional measurement information acquisition step (s2, t4, u4), the plurality of pieces of narrow range three-dimensional measurement information (In) being measured at a higher resolution than that of the wide range three-dimensional measuring information (Iw).

4. An intraoral three-dimensional measuring method according to any one of claims 1 through 3, wherein in the synthetic three-dimensional information creation step (s3, t5, u8), the synthetic three-dimensional information (Ic) being created by use of, as intra-measurement range position information, characteristic portion information common to each of the plurality of pieces of narrow range three-dimensional measurement information (In) and the wide range three-dimensional measurement information (Iw).

5. An intraoral three-dimensional measuring method according to any one of claims 1 through 4, further comprising a position information acquisition step of acquiring position information on each of the plurality of pieces of narrow range three-dimensional measurement information (In) and acquiring position information on the wide range three-dimensional measurement information (Iw);
in the synthetic three-dimensional information creation step (s3, t5, u8), the synthetic three-dimensional information (Ic) being adjusted based on the position information acquired in the position information acquisition step.

6. An intraoral three-dimensional measuring method according to any one of claims 1 through 5, wherein in the synthetic three-dimensional information creation step (s3, t5, u8), a part of the wide range three-dimensional measurement information (Iw) corresponding to each piece of narrow range three-dimensional measurement information (In) being overwritten (s5, t7, u10) with the each piece of narrow range three-dimensional measurement information (In).

7. An intraoral three-dimensional measuring method according to any one of claims 1 through 6, the wide range three-dimensional measurement information (Iw) being entire measurement information on a shape of the entirety of the measurement range.

8. An intraoral three-dimensional measuring method according to any one of claims 1 through 6, further comprising an entire joining measurement information creation step (t3, u3) of locating a plurality of pieces of the wide range three-dimensional measurement information (Iw) by use of, as a joining reference, wide range position information common to adjacent pieces of wide range three-dimensional measurement information (Iw), to create entire joining measurement information on the entirety of the measurement range.

9. An intraoral three-dimensional measuring method according to claim 8,
at least one of the plurality of pieces of the narrow range three-dimensional measurement information (In) being adjustment narrow range three-dimensional measurement information including measurement information on a part corresponding to the wide range position information (Iw); and
the intraoral three-dimensional measuring method further comprising an entire joining measurement information adjustment step (u6, u7) of adjusting the entire joining measurement information based on the adjustment narrow range three-dimensional measurement information located in the synthetic three-dimensional information creation step.

10. An intraoral three-dimensional measurement result display method for creating images based on the wide range three-dimensional measurement information (Iw) and the plurality of pieces of narrow range three-dimensional measurement information (In) by the intraoral three-dimensional measuring method according to any one of claims 1 through 9 and displaying the images in an overlapping manner.

11. An intraoral three-dimensional measurement result display method according to claim 10, the wide range three-dimensional measurement information (Iw) and the plurality of pieces of narrow range three-dimensional measurement information (In) displayed as the images in an overlapping manner being displayed with at least one of brightness, color, luminance and display pattern being different between the images.

12. An intraoral three-dimensional measuring device, comprising:

a measurement information acquisition unit (20, 21) adapted to acquire wide range three-dimensional measurement information (Iw) on a three-dimensional shape measured on a wide range (Rw) in a desirable measurement range in an intraoral space, and to acquire a plurality of pieces of narrow range three-dimensional measurement information (In) each on a three-dimensional shape measured on a narrow range (Rn) narrower than the wide range (Rw) in the measurement range; and
a synthetic three-dimensional information creation unit (20, 21) adapted to repeatedly locate each of the plurality of pieces of narrow range three-dimensional measurement information (In) at its respective position based on the wide range three-dimensional measurement information (Iw) by use of, as a synthesis reference, intra-measurement range position information common to the wide range three-dimensional measurement information and each of the plurality of pieces of narrow range three-dimensional measurement information, to create synthetic three-dimensional information (Ic) on the measurement range.

13. An intraoral three-dimensional measuring device according to claim 12, further being adapted
to use the wide range three-dimensional measurement information (Iw) to create wide range three-dimensional image information on the three-dimensional shape of the wide range; and
to use each of the plurality of pieces of narrow range three-dimensional measurement information (In) to create narrow range three-dimensional image information on the three-dimensional shape of the narrow range;
wherein the synthetic three-dimensional information creation unit (20, 21) is adapted to create synthetic three-dimensional image information (Ic) based on the synthetic three-dimensional information.

14. An intraoral three-dimensional measuring device according to claim 12 or 13, further being adapted to measure the plurality of pieces of narrow range three-dimensional measurement information (In) at a higher resolution than that of the wide range three-dimensional measuring information (Iw).

15. An intraoral three-dimensional measuring device according to any one of claims 12 through 14, wherein the synthetic three-dimensional information creation unit (20, 21) is adapted to create the synthetic three-dimensional information (Ic) by use of, as the intra-measurement range position information, characteristic portion information common to the each of plurality of pieces of narrow range three-dimensional measurement information (In) and the wide range three-dimensional measurement information (Iw).

16. An intraoral three-dimensional measuring device according to any one of claims 12 through 15, further comprising a position information acquisition unit (40) adapted to acquire position information on each of the plurality of pieces of narrow range three-dimensional measurement information (In) and acquiring position information on the wide range three-dimensional measurement information (Iw);
the synthetic three-dimensional information creation unit (20, 21) being adapted to adjust the synthetic three-dimensional information (Ic) based on the position information acquired by the position information acquisition unit (40).

17. An intraoral three-dimensional measuring device according to any one of claims 12 through 16, the measurement information acquisition unit (20, 21) comprising a three-dimensional measurement element including:

a light source (111) emitting projection light toward a measurement target;
an image capturing element (113) capturing an image of an area irradiated with the projection light;
a guide path (132) guiding light reflected by the measurement target toward the image capturing element (113); and
a handheld housing (110) accommodating the light source (111), the guide path (132) and the image capturing element (113).

18. An intraoral three-dimensional measuring device according to claim 17, the guide path including:

a wide range guide path (132a) usable to measure the wide range;
a narrow range guide path (132b) usable to measure the narrow range; and
a switching unit (20, 21) switching the guide path to the wide range guide path (132a) or to the narrow range guide path (132b).

19. An intraoral three-dimensional measuring device according to claim 17 or 18, wherein a part of the housing (110) includes an exchangeable unit (120) that includes at least the guide path (132) and is detachable and exchangeable to change the measurement range.

20. An intraoral three-dimensional measuring device according to claim 17 or 18, further comprising an attachment (120) that includes at least the guide path (132) and is detachable from the housing (110) to change the measurement range.

Patentansprüche

1. Verfahren zur intraoralen dreidimensionalen Messung, aufweisend:

einen Schritt (s1, t1, u1) zur Erfassung einer dreidimensionalen Messinformation über einen weiten Bereich, um eine dreidimensionale Messinformation (Iw) über einen weiten Bereich über eine dreidimensionale Form zu erfassen, die über einen weiten Bereich (Rw) in einem erwünschten Messbereich in einem intraoralen Raum vermessen wird;
einen Schritt (s2, t4, u4) zur Erfassung einer dreidimensionalen Messinformation über einen schmalen Bereich, um jeweils eine Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich über eine dreidimensionale Form zu erfassen, die über einen schmalen Bereich (Rn), der schmaler als der weite Bereich (Rw) ist, im Messbereich vermessen wird; und
einen Schritt (s3, t5, u8) zur Erzeugung einer synthetischen dreidimensionalen Information, um jedes der Vielzahl von Stücken einer dreidimensionalen Messinformation über einen schmalen Bereich an dessen jeweiliger Position basierend auf der dreidimensionalen Messinformation (Iw) über einen weiten Bereich unter Verwendung, als Synthese-Referenz, einer Information über Positionen von Intra-Messbereichen wiederholt zu lokalisieren, die der dreidimensionalen Messinformation (Iw) über einen weiten Bereich und jedem der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich gemeinsam ist, um eine synthetische dreidimensionale Information über den Messbereich zu erzeugen.

2. Verfahren zur intraoralen dreidimensionalen Messung nach Anspruch 1,
wobei die dreidimensionale Messinformation über einen weiten Bereich verwendet wird, um eine dreidimensionale Bildinformation (Iw) über einen weiten Bereich über die dreidimensionale Form des weiten Bereichs (Rw) zu erzeugen;
die Vielzahl von Stücken einer dreidimensionalen Messinformation über einen schmalen Bereich jeweils verwendet wird, um eine dreidimensionale Bildinformation (In) über einen schmalen Bereich über die dreidimensionale Form des schmalen Bereichs (Rw) zu erzeugen; und
im Schritt zur Erzeugung einer synthetischen dreidimensionalen Information basierend auf der synthetischen dreidimensionalen Information eine synthetische dreidimensionale Bildinformation (Ic) erzeugt wird.

3. Verfahren zur intraoralen dreidimensionalen Messung nach Anspruch 1 oder 2, wobei in dem Schritt (s2, t4, u4) zur Erfassung einer dreidimensionalen Messinformation über einen schmalen Bereich die Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich mit einer höheren Auflösung als derjenigen der dreidimensionalen Messinformation (Iw) über einen weiten Bereich gemessen wird.

4. Verfahren zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 1 bis 3, wobei in dem Schritt (s3, t5, u8) zur Erzeugung einer synthetischen dreidimensionalen Information die synthetische dreidimensionalen Information (Ic) unter Verwendung, als Information über Positionen von Intra-Messbereichen, einer charakteristischen Teilinformation erzeugt wird, die jedem der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich und der dreidimensionalen Messinformation (Iw) über einen weiten Bereich gemeinsam ist.

5. Verfahren zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 1 bis 4, ferner aufweisend einen Schritt zur Erfassung einer Positionsinformation, um eine Positionsinformation über jedes der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich zu erfassen und eine Positionsinformation über die dreidimensionale Messinformation (Iw) über einen weiten Bereich zu erfassen;
wobei in dem Schritt (s3, t5, u8) zur Erzeugung einer synthetischen dreidimensionalen Information die synthetische dreidimensionale Information (Ic) basierend auf der Positionsinformation, die in dem Schritt zur Erfassung einer Positionsinformation erfasst wurde, justiert wird.

6. Verfahren zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 1 bis 5, wobei in dem Schritt (s3, t5, u8) zur Erzeugung einer synthetischen dreidimensionalen Information ein Teil der dreidimensionalen Messinformation (Iw) über einen weiten Bereich, der je einem Stück einer dreidimensionalen Messinformation (In) über einen schmalen Bereich entspricht, mit dem jeweiligen Stück einer dreidimensionalen Messinformation (In) über einen schmalen Bereich überschrieben (s5, t7, u10) wird.

7. Verfahren zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 1 bis 6, wobei die dreidimensionale Messinformation (Iw) über einen weiten Bereich eine vollständige Messinformation über eine Form des gesamten Messbereichs ist.

8. Verfahren zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 1 bis 6, ferner aufweisend einen Schritt (t3, u3) zur Erzeugung einer vollständigen, sich aneinanderfügenden Messinformation, um eine Vielzahl von Stücken der dreidimensionalen Messinformation (Iw) über einen weiten Bereich unter Verwendung, als Referenz zum Aneinanderfügen, einer Positionsinformation über einen weiten Bereich zu lokalisieren, die benachbarten Stücken einer dreidimensionalen Messinformation (Iw) über einen weiten Bereich gemeinsam ist, um eine vollständige, sich aneinanderfügende Messinformation über den gesamten Messbereich zu erzeugen.

9. Verfahren zur intraoralen dreidimensionalen Messung nach Anspruch 8,
wobei zumindest eines der Vielzahl von Stücken der dreidimensionalen Messinformation (In) über einen schmalen Bereich eine dreidimensionale Messinformation über einen schmalen Bereich für eine Justierung ist, die eine Messinformation über einen Teil enthält, der der Positionsinformation (Iw) über einen weiten Bereich entspricht; und
das Verfahren zur intraoralen dreidimensionalen Messung ferner einen Schritt (u6, u7) zur Justierung einer vollständigen, sich aneinanderfügenden Messinformation aufweist, um die vollständige, sich aneinanderfügende Messinformation basierend auf der dreidimensionalen Messinformation über einen schmalen Bereich für eine Justierung zu justieren, die im Schritt zur Erzeugung einer synthetischen dreidimensionalen Information lokalisiert wird.

10. Verfahren zur Anzeige von Ergebnissen einer intraoralen dreidimensionalen Messung zum Erzeugen von Bildern, basierend auf der dreidimensionalen Messinformation (Iw) über einen weiten Bereich und der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich, durch das Verfahren zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 1 bis 9 und überlappenden Anzeigen der Bilder.

11. Verfahren zur Anzeige von Ergebnissen einer intraoralen dreidimensionalen Messung nach Anspruch 10, wobei die dreidimensionale Messinformation (Iw) über einen weiten Bereich und die Vielzahl von Stücken einer dreidimensionalen Information (In) über einen schmalen Bereich, die als die Bilder überlappend angezeigt werden, angezeigt werden, wobei zwischen den Bildern eine Helligkeit, eine Farbe, eine Leuchtstärke und/oder ein Anzeigemuster verschieden sind/ist.

12. Vorrichtung zur intraoralen dreidimensionalen Messung, aufweisend:

eine Einheit (20, 21) zur Erfassung einer Messinformation, die dafür geeignet ist, eine dreidimensionale Messinformation (Iw) über einen weiten Bereich über eine dreidimensionale Form zu erfassen, die über einen weiten Bereich (Rw) in einem erwünschten Messbereich in einem intraoralen Raum vermessen wird, und jeweils eine Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich über eine dreidimensionale Form zu erfassen, die über einen schmalen Bereich (Rn), der schmaler als der weite Bereich (Rw) ist, im Messbereich vermessen wird; und
eine Einheit (20, 21) zur Erzeugung einer synthetischen dreidimensionalen Information, die dafür geeignet ist, jedes der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich an dessen jeweiliger Position basierend auf der dreidimensionalen Messinformation (Iw) über einen weiten Bereich unter Verwendung, als Synthese-Referenz, einer Information über Positionen von Intra-Messbereichen wiederholt zu lokalisieren, die der dreidimensionalen Messinformation über einen weiten Bereich und jedem der Vielzahl von Stücken einer dreidimensionalen Messinformation über einen schmalen Bereich gemeinsam ist, um eine synthetische dreidimensionale Information (Ic) über den Messbereich zu erzeugen.

13. Vorrichtung zur intraoralen dreidimensionalen Messung nach Anspruch 12, wobei sie ferner dafür geeignet ist,
die dreidimensionale Messinformation (Iw) über einen weiten Bereich zu verwenden, um eine dreidimensionale Bildinformation über einen weiten Bereich über die dreidimensionale Form des weiten Bereichs zu erzeugen; und
jedes der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich zu verwenden, um eine dreidimensionale Bildinformation über einen schmalen Bereich über die dreidimensionale Form des schmalen Bereichs zu erzeugen; und
wobei die Einheit (20, 21) zur Erzeugung einer syn-

thetischen dreidimensionalen Information dafür geeignet ist, basierend auf der synthetischen dreidimensionalen Information eine synthetische dreidimensionale Bildinformation (Ic) zu erzeugen.

14. Vorrichtung zur intraoralen dreidimensionalen Messung nach Anspruch 12 oder 13, wobei sie ferner dafür geeignet ist, die Vielzahl von Stücken einer dreidimensionalen Information (In) über einen schmalen Bereich mit einer höheren Auflösung als derjenigen der dreidimensionalen Messinformation (Iw) über einen weiten Bereich zu messen.

15. Vorrichtung zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 12 bis 14, wobei die Einheit (20, 21) zur Erzeugung einer synthetischen dreidimensionalen Information dafür geeignet ist, die synthetische dreidimensionalen Information (Ic) unter Verwendung, als Information über Positionen von Intra-Messbereichen, einer charakteristischen Teilinformation zu erzeugen, die jedem der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich und der dreidimensionalen Messinformation (Iw) über einen weiten Bereich gemeinsam ist.

16. Vorrichtung zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 12 bis 15, ferner aufweisend eine Einheit (40) zur Erfassung einer Positionsinformation, die dafür geeignet ist, eine Positionsinformation über jedes der Vielzahl von Stücken einer dreidimensionalen Messinformation (In) über einen schmalen Bereich zu erfassen und eine Positionsinformation über die dreidimensionale Messinformation (Iw) über einen weiten Bereich zu erfassen;
wobei die Einheit (20, 21) zur Erzeugung einer synthetischen dreidimensionalen Information dafür geeignet ist, die synthetische dreidimensionale Information (Ic) basierend auf der Positionsinformation, die durch die Einheit (40) zur Erfassung einer Positionsinformation erfasst wird, zu justieren.

17. Vorrichtung zur intraoralen dreidimensionalen Messung nach einem der Ansprüche 12 bis 16, wobei die Einheit (20, 21) zur Erfassung einer Messinformation ein Element zur dreidimensionalen Messung aufweist, welches umfasst:

eine Lichtquelle (111), die ein Projektionslicht in Richtung eines Messziels emittiert;
eine Bildaufnahmeeinheit (113), das ein Bild einer mit dem Projektionslicht bestrahlten Fläche aufnimmt;
einen Leitweg (132), der vom Messziel reflektiertes Licht in Richtung des Bildaufnahmeelements (113) leitet; und
ein in der Hand zu haltendes Gehäuse (110), das die Lichtquelle (111), den Leitweg (132) und das Bildaufnahmeelement (113) beherbergt.

18. Vorrichtung zur intraoralen dreidimensionalen Messung nach Anspruch 17, wobei der Leitweg umfasst:

einen Leitweg (132a) für einen weiten Bereich, der genutzt werden kann, um den weiten Bereich zu vermessen;
einen Leitweg (132b) für einen schmalen Bereich, der genutzt werden kann, um den schmalen Bereich zu vermessen;
eine Umschalteinheit (20, 21), die den Leitweg auf den Leitweg (132a) für einen weiten Bereich oder auf den Leitweg (132b) für einen schmalen Bereich umschaltet.

19. Vorrichtung zur intraoralen dreidimensionalen Messung nach Anspruch 17 oder 18, wobei ein Teil des Gehäuses (110) eine austauschbare Einheit (120) enthält, die zumindest den Leitweg (132) enthält und abnehmbar und austauschbar ist, um den Messbereich zu ändern.

20. Vorrichtung zur intraoralen dreidimensionalen Messung nach Anspruch 17 oder 18, ferner aufweisend ein Zubehör (120), das zumindest den Leitweg (132) enthält und vom Gehäuse (110) abnehmbar ist, um den Messbereich zu ändern.

Revendications

1. Procédé de mesure tridimensionnelle intra-orale, comprenant :

une étape d'acquisition d'informations de mesure tridimensionnelle de plage étendue (s1, t1, u1) consistant à acquérir des informations de mesure tridimensionnelle de plage étendue (Iw) sur une forme tridimensionnelle mesurée sur une plage étendue (Rw) dans une plage de mesures souhaitable dans un espace intra-oral ;
une étape d'acquisition d'informations de mesure tridimensionnelle de plage étroite (s2, t4, u4) consistant à acquérir une pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) chacun sur une forme tridimensionnelle mesurée sur une plage étroite (Rn) plus étroite que la plage étendue (Rw) dans la plage de mesures ; et
une étape de création d'informations tridimensionnelles de synthèse (s3, t5, u8) consistant à localiser de manière répétée chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite à sa position respective sur la base des informations de mesure tridimensionnelle de plage étendue (Iw) par l'uti-

lisation, en tant que référence de synthèse, d'informations de position de mesure intra-plage communes aux informations de mesure tridimensionnelle de plage étendue (Iw) et de chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In), pour créer des informations tridimensionnelles de synthèse sur la plage de mesures.

2. Procédé de mesure tridimensionnelle intra-orale selon la revendication 1,
les informations de mesure tridimensionnelle de plage étendue étant utilisées pour créer des informations d'image tridimensionnelle de plage étendue (Iw) sur la forme tridimensionnelle de la plage étendue (Rw) ;
la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite étant chacun utilisés pour créer des informations d'image tridimensionnelle de plage étroite (In) sur la forme tridimensionnelle de la plage étroite (Rn) ; et
dans l'étape de création d'informations tridimensionnelles de synthèse, des informations d'image tridimensionnelle de synthèse (Ic) étant créées sur la base des informations tridimensionnelles de synthèse.

3. Procédé de mesure tridimensionnelle intra-orale selon la revendication 1 ou 2, dans lequel, dans l'étape d'acquisition d'informations de mesure tridimensionnelle de plage étroite (s2, t4, u4), la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) étant mesurés à une résolution plus grande que celle des informations de mesure tridimensionnelle de plage étendue (Iw).

4. Procédé de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 1 à 3, dans lequel, dans l'étape de création d'informations tridimensionnelles de synthèse (s3, t5, u8), les informations tridimensionnelles de synthèse (Ic) étant créées par l'utilisation, en tant qu'informations de position de mesure intra-plage, d'informations de portion de caractéristique communes à chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) et aux informations de mesure tridimensionnelle de plage étendue (Iw).

5. Procédé de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 1 à 4, comprenant en outre une étape d'acquisition d'informations de position consistant à acquérir des informations de position sur chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) et à acquérir des informations de position sur les informations de mesure tridimensionnelle de plage étendue (Iw) ;
dans l'étape de création d'informations tridimensionnelles de synthèse (s3, t5, u8), les informations tridimensionnelles de synthèse (Ic) étant ajustées sur la base des informations de position acquises dans l'étape d'acquisition d'informations de position.

6. Procédé de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 1 à 5, dans lequel dans l'étape de création d'informations tridimensionnelles de synthèse (s3, t5, u8), une partie des informations de mesure tridimensionnelle de plage étendue (Iw) correspondant à chaque élément d'informations de mesure tridimensionnelle de plage étroite (In) étant écrasée (s5, t7, u10) avec chaque élément d'informations de mesure tridimensionnelle de plage étroite (In).

7. Procédé de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 1 à 6, les informations de mesure tridimensionnelle de plage étendue (Iw) étant des informations de mesure complètes sur une forme de l'intégralité de la plage de mesures.

8. Procédé de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 1 à 6, comprenant en outre une étape de création d'informations de mesure de jonction complètes (t3, u3) consistant à localiser une pluralité d'éléments des informations de mesure tridimensionnelle de plage étendue (Iw) par l'utilisation, en tant que référence de jonction, d'informations de position de plage étendue communes à des éléments adjacents d'informations de mesure tridimensionnelle de plage étendue (Iw), pour créer des informations de mesure de jonction complètes sur l'intégralité de la plage de mesures.

9. Procédé de mesure tridimensionnelle intra-orale selon la revendication 8,
au moins un de la pluralité d'éléments des informations de mesure tridimensionnelle de plage étroite (In) étant des informations de mesure tridimensionnelle de plage étroite d'ajustement incluant des informations de mesure sur une partie correspondant aux informations de position de plage étendue (Iw) ; et
le procédé de mesure tridimensionnelle intra-orale comprenant en outre une étape d'ajustement d'informations de mesure de jonction complètes (u6, u7) consistant à ajuster les informations de mesure de jonction complètes sur la base des informations de mesure tridimensionnelle de plage étroite d'ajustement localisées dans l'étape de création d'informations tridimensionnelles de synthèse.

10. Procédé d'affichage de résultat de mesure tridimensionnelle intra-orale pour créer des images sur la base des informations de mesure tridimensionnelle de plage étendue (Iw) et de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) par le procédé de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 1 à 9 et afficher les images se recouvrant en partie.

11. Procédé d'affichage de résultat de mesure tridimensionnelle intra-orale selon la revendication 10, les informations de mesure tridimensionnelle de plage étendue (Iw) et la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) affichés en tant qu'images se recouvrant en partie étant affichés avec au moins un de luminosité, couleur, luminance et modèle d'affichage étant différent entre les images.

12. Dispositif de mesure tridimensionnelle intra-orale, comprenant :

une unité d'acquisition d'informations de mesure (20, 21) adaptée pour acquérir des informations de mesure tridimensionnelle de plage étendue (Iw) sur une forme tridimensionnelle mesurée sur une plage étendue (Rw) dans une plage de mesures souhaitable dans un espace intra-oral, et pour acquérir une pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) chacun sur une forme tridimensionnelle mesurée sur une plage étroite (Rn) plus étroite que la plage étendue (Rw) dans la plage de mesures ; et

une unité de création d'informations tridimensionnelles de synthèse (20, 21) adaptée pour localiser de manière répétée chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) à sa position respective sur la base des informations de mesure tridimensionnelle de plage étendue (Iw) par l'utilisation, en tant que référence de synthèse, d'informations de position de mesure intra-plage communes aux informations de mesure tridimensionnelle de plage étendue et à chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite, pour créer des informations tridimensionnelles de synthèse (Ic) sur la plage de mesures.

13. Dispositif de mesure tridimensionnelle intra-orale selon la revendication 12, étant en outre adapté pour utiliser les informations de mesure tridimensionnelle de plage étendue (Iw) pour créer des informations d'image tridimensionnelle de plage étendue sur la forme tridimensionnelle de la plage étendue ; et
pour utiliser chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) pour créer des informations d'image tridimensionnelle de plage étroite sur la forme tridimensionnelle de la plage étroite ;
dans lequel l'unité de création d'informations tridimensionnelles de synthèse (20, 21) est adaptée pour créer des informations d'image tridimensionnelle de synthèse (Ic) sur la base des informations tridimensionnelles de synthèse.

14. Dispositif de mesure tridimensionnelle intra-orale selon la revendication 12 ou 13, étant en outre adapté pour mesurer la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) à une résolution plus grande que celle des informations de mesure tridimensionnelle de plage étendue (Iw).

15. Dispositif de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 12 à 14, dans lequel l'unité de création d'informations tridimensionnelles de synthèse (20, 21) est adaptée pour créer les informations tridimensionnelles de synthèse (Ic) par l'utilisation, en tant qu'informations de position de mesure intra-plage, d'informations de portion de caractéristique communes à chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) et aux informations de mesure tridimensionnelle de plage étendue (Iw).

16. Dispositif de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 12 à 15, comprenant en outre une unité d'acquisition d'informations de position (40) adaptée pour acquérir des informations de position sur chacun de la pluralité d'éléments d'informations de mesure tridimensionnelle de plage étroite (In) et pour acquérir des informations de position sur les informations de mesure tridimensionnelle de plage étendue (Iw) ;
l'unité de création d'informations tridimensionnelles de synthèse (20, 21) étant adaptée pour ajuster les informations tridimensionnelles de synthèse (Ic) sur la base des informations de position acquises par l'unité d'acquisition d'informations de position (40).

17. Dispositif de mesure tridimensionnelle intra-orale selon l'une quelconque des revendications 12 à 16, l'unité d'acquisition d'informations de mesure (20, 21) comprenant un élément de mesure tridimensionnelle incluant :

une source de lumière (111) émettant une lumière de projection vers une cible de mesure ;
un élément de capture d'image (113) capturant une image d'une zone irradiée avec la lumière de projection ;
un chemin de guidage (132) guidant la lumière réfléchie par la cible de mesure vers l'élément de capture d'image (113) ; et

un boîtier portatif (110) logeant la source de lumière (111), le chemin de guidage (132) et l'élément de capture d'image (113).

18. Dispositif de mesure tridimensionnelle intra-orale selon la revendication 17, le chemin de guidage incluant :

un chemin de guidage de plage étendue (132a) utilisable pour mesurer la plage étendue ;
un chemin de guidage de plage étroite (132b) utilisable pour mesurer la plage étroite ; et
une unité de commutation (20, 21) commutant le chemin de guidage vers le chemin de guidage de plage étendue (132a) ou vers le chemin de guidage de plage étroite (132b).

19. Dispositif de mesure tridimensionnelle intra-orale selon la revendication 17 ou 18, dans lequel
une partie du boîtier (110) inclut une unité échangeable (120) qui inclut au moins le chemin de guidage (132) et est détachable et échangeable pour changer la plage de mesures.

20. Dispositif de mesure tridimensionnelle intra-orale selon la revendication 17 ou 18, comprenant en outre un accessoire (120) qui inclut au moins le chemin de guidage (132) et est détachable du boîtier (110) pour changer la plage de mesures.

FIG. 1

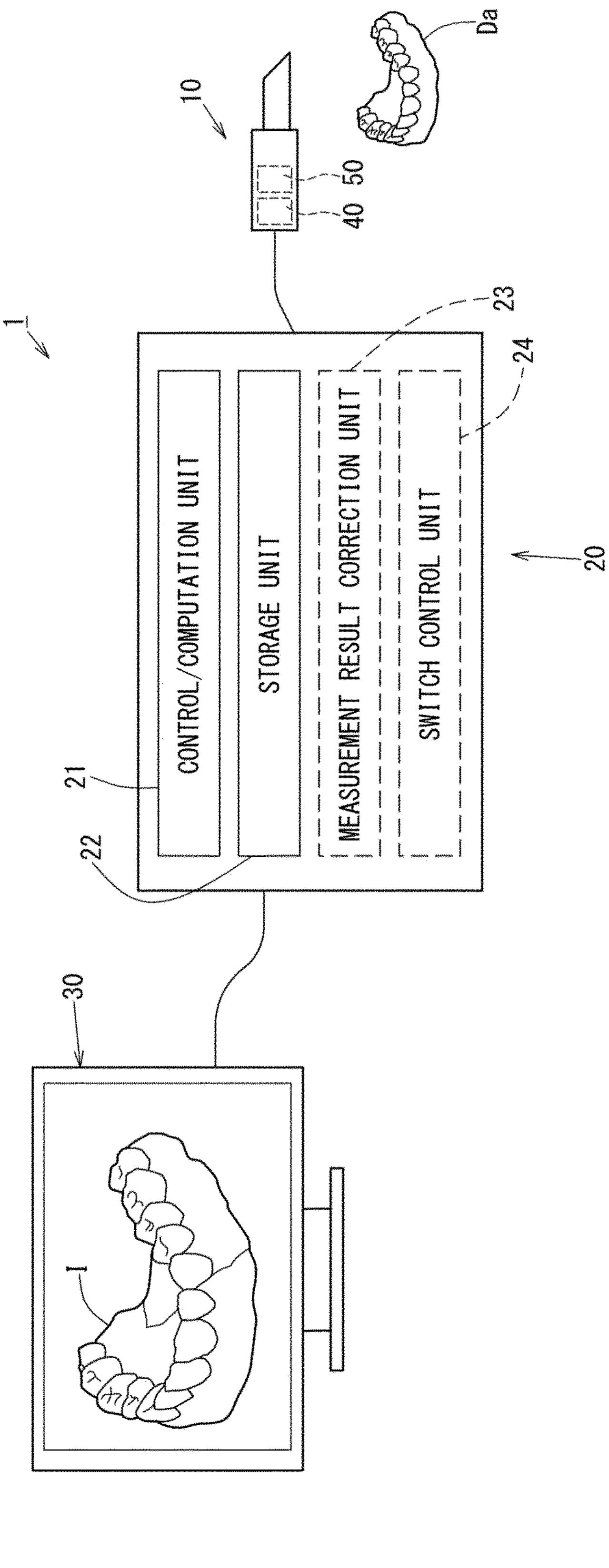

Da
10
50
40
1
23
24
CONTROL/COMPUTATION UNIT
STORAGE UNIT
MEASUREMENT RESULT CORRECTION UNIT
SWITCH CONTROL UNIT
20
21
22
30
I

FIG. 2

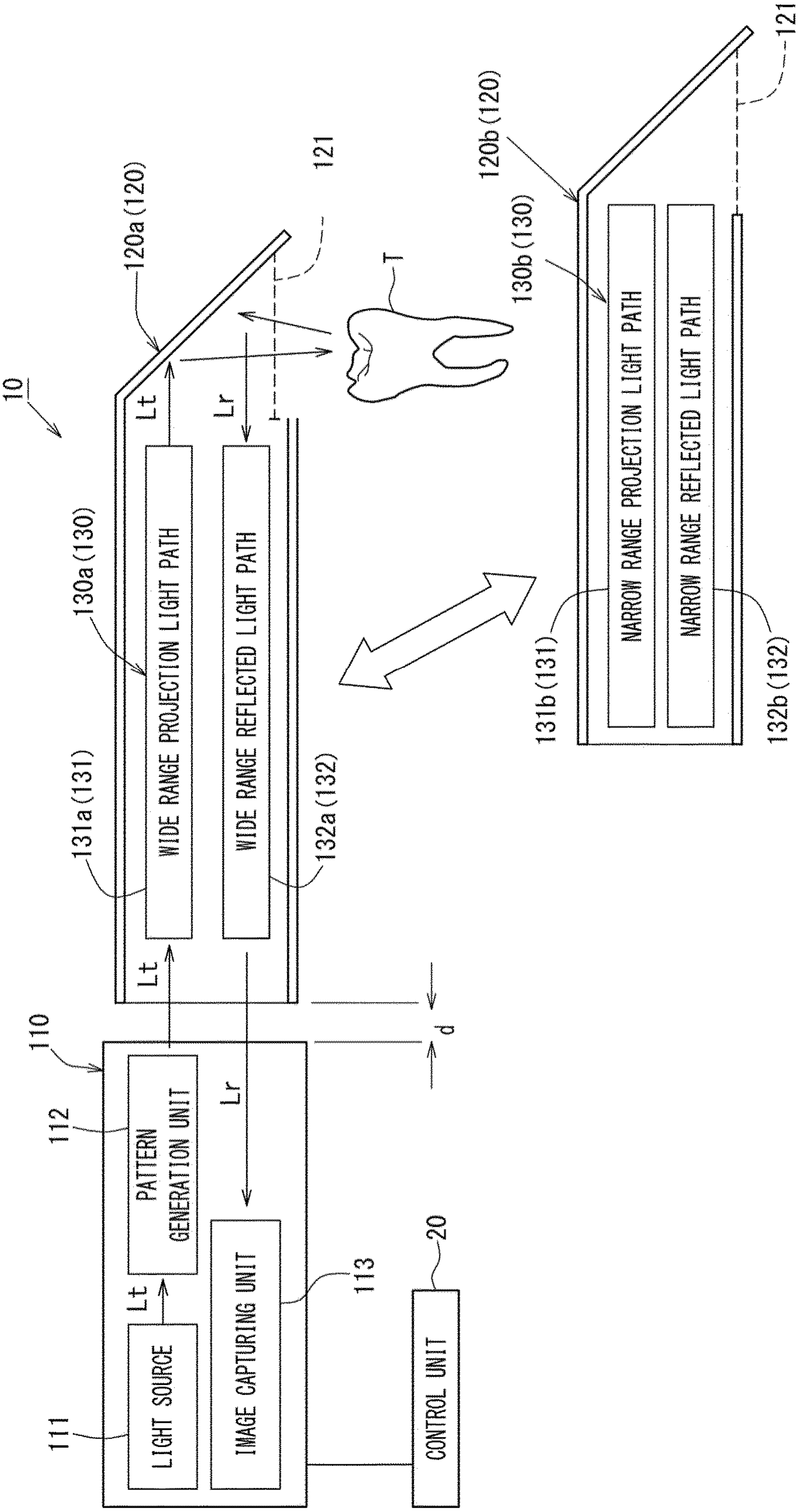

10
120a (120)
121
T
Lt
Lr
130a (130)
WIDE RANGE PROJECTION LIGHT PATH
WIDE RANGE REFLECTED LIGHT PATH
131a (131)
132a (132)
120b (120)
130b (130)
NARROW RANGE PROJECTION LIGHT PATH
NARROW RANGE REFLECTED LIGHT PATH
131b (131)
132b (132)
d
110
112
PATTERN GENERATION UNIT
111
LIGHT SOURCE
IMAGE CAPTURING UNIT
113
20
CONTROL UNIT

FIG. 3

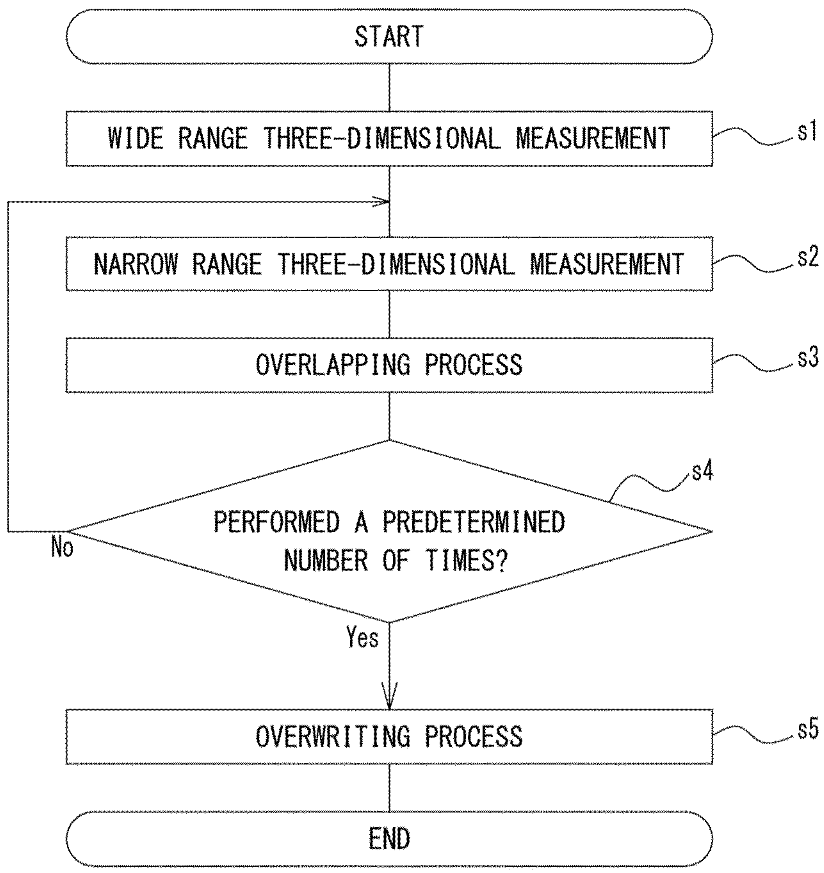

START
WIDE RANGE THREE-DIMENSIONAL MEASUREMENT
s1
NARROW RANGE THREE-DIMENSIONAL MEASUREMENT
s2
OVERLAPPING PROCESS
s3
PERFORMED A PREDETERMINED NUMBER OF TIMES?
s4
No
Yes
OVERWRITING PROCESS
s5
END

FIG. 4

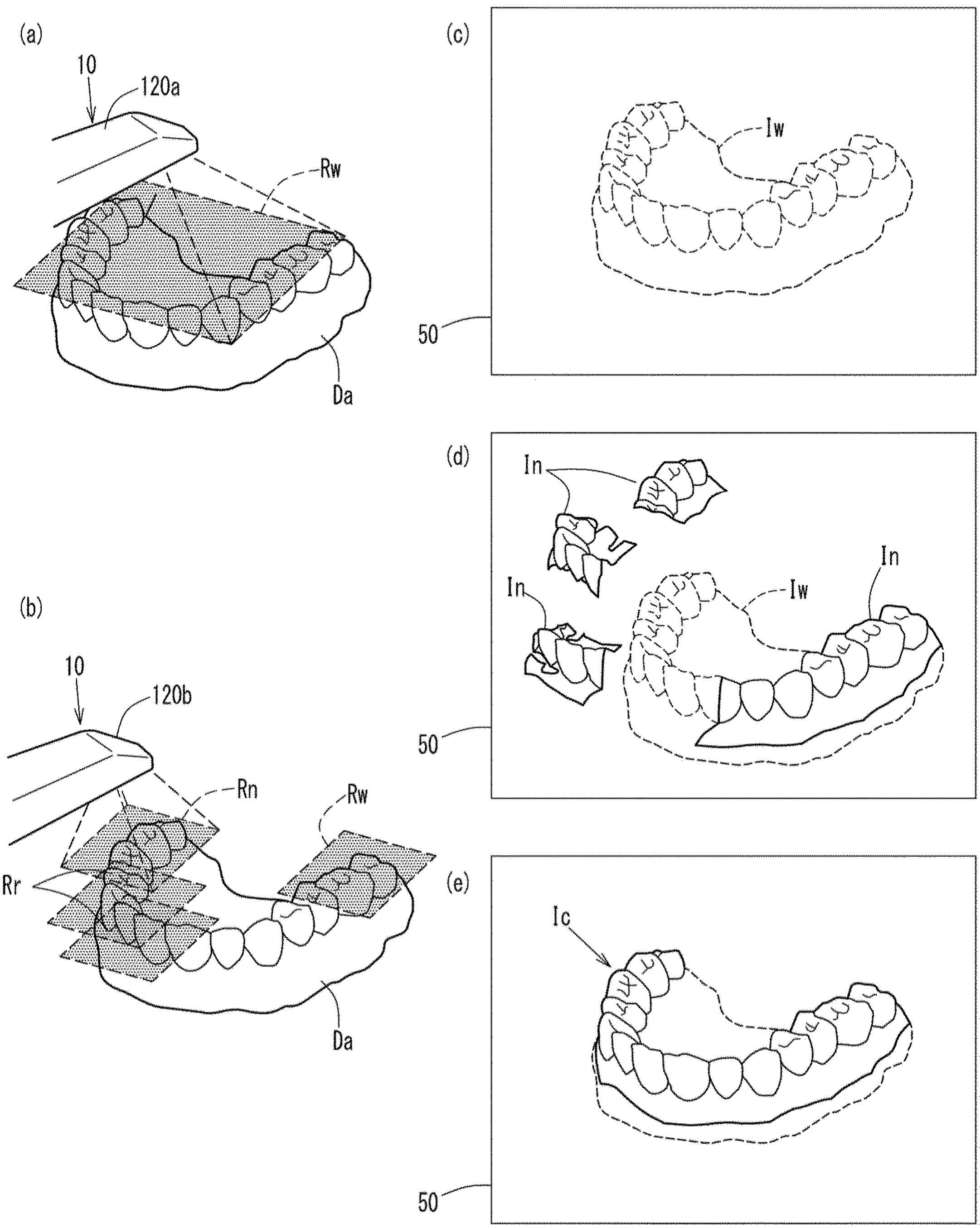


FIG. 5

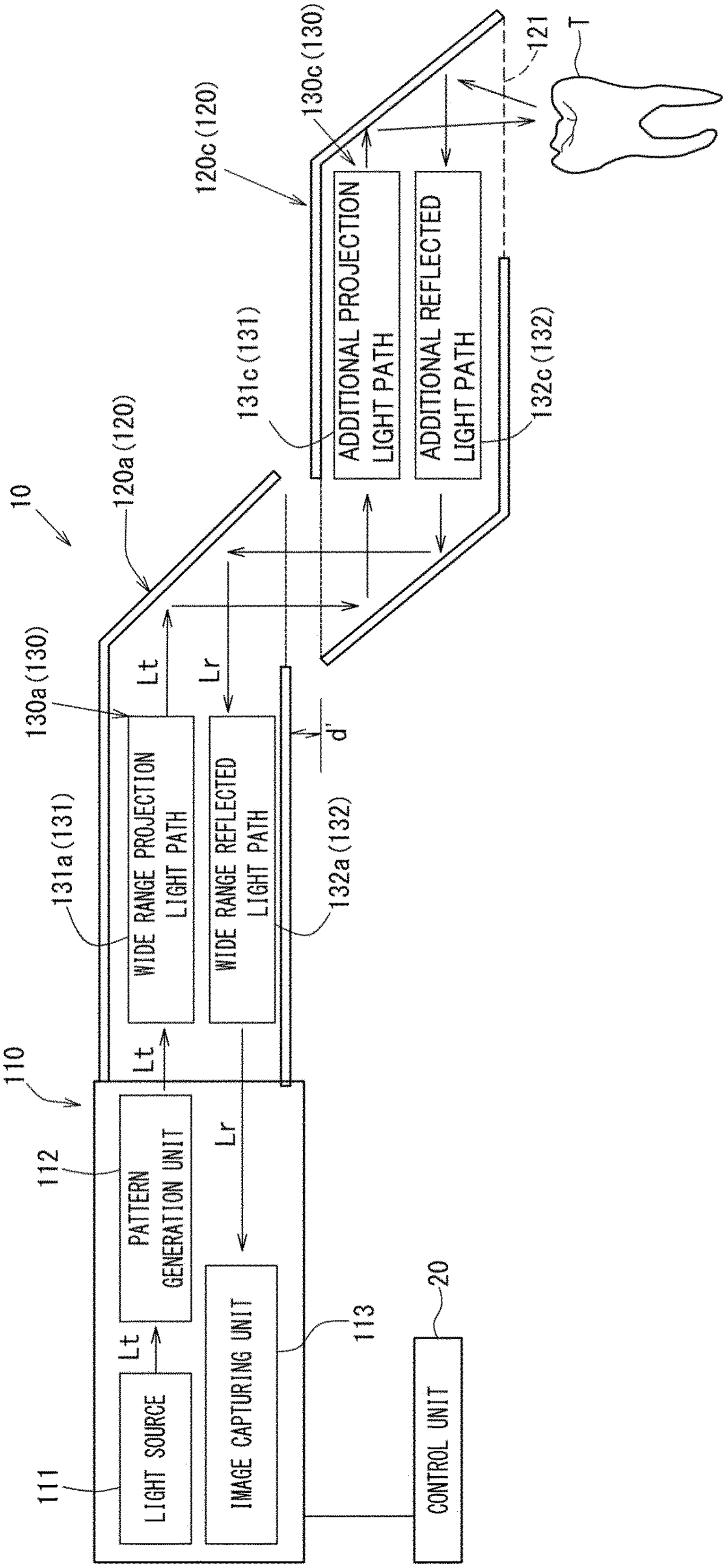
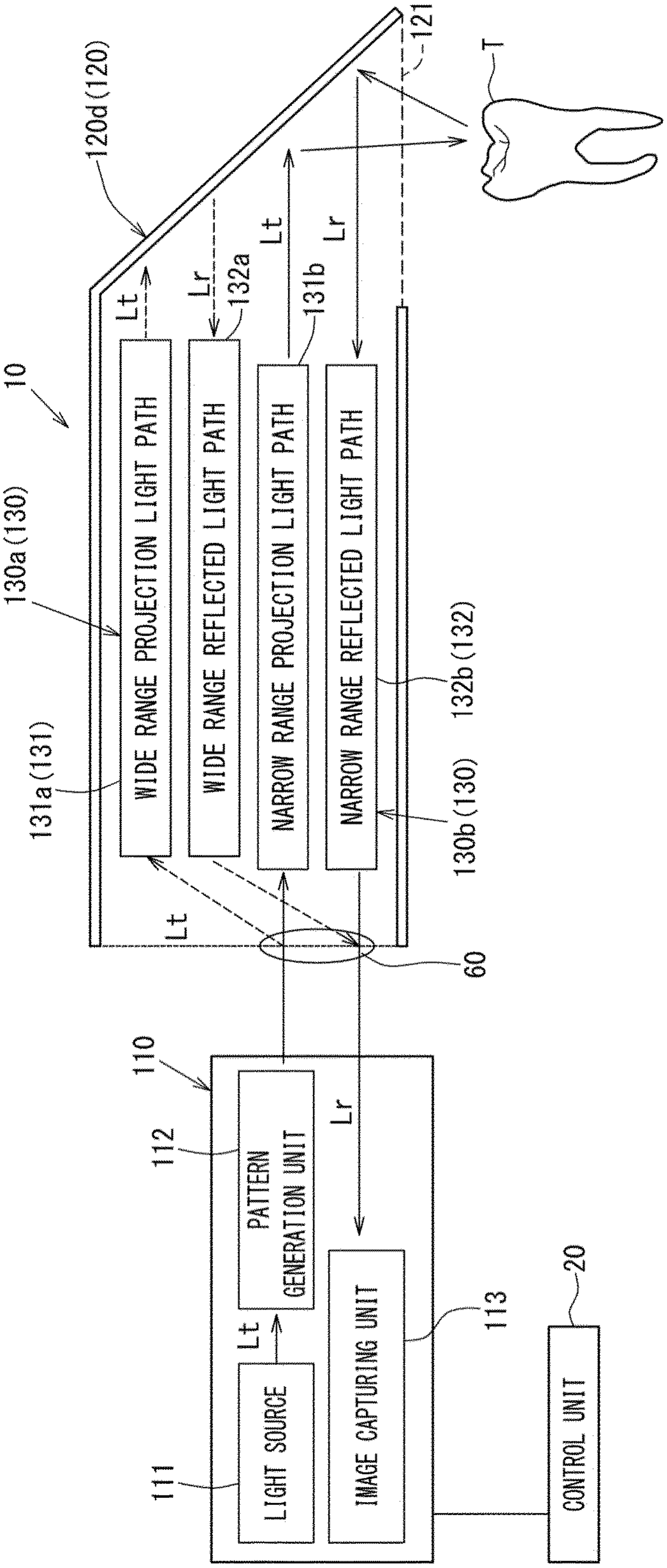

10
110
111
112
113
20
LIGHT SOURCE
Lt
PATTERN GENERATION UNIT
IMAGE CAPTURING UNIT
Lr
CONTROL UNIT
131a (131)
WIDE RANGE PROJECTION LIGHT PATH
132a (132)
WIDE RANGE REFLECTED LIGHT PATH
130a (130)
120a (120)
d'
131c (131)
ADDITIONAL PROJECTION LIGHT PATH
132c (132)
ADDITIONAL REFLECTED LIGHT PATH
120c (120)
130c (130)
121
T

FIG. 6



10
120d(120)
121
T
130a(130)
131a(131)
WIDE RANGE PROJECTION LIGHT PATH
WIDE RANGE REFLECTED LIGHT PATH
NARROW RANGE PROJECTION LIGHT PATH
NARROW RANGE REFLECTED LIGHT PATH
132a
131b
132b(132)
130b(130)
Lt
Lr
60
110
111
112
113
LIGHT SOURCE
PATTERN GENERATION UNIT
IMAGE CAPTURING UNIT
20
CONTROL UNIT

FIG. 7

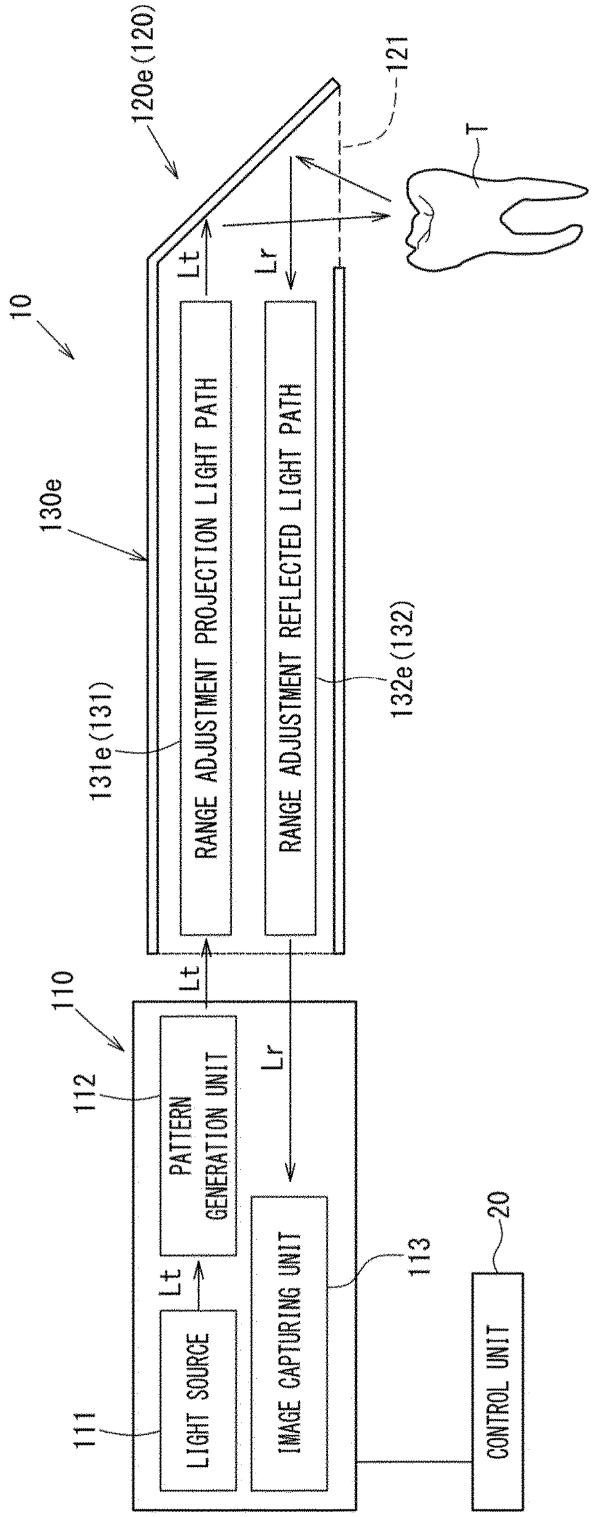

120e(120)
121
T
10
Lt
Lr
130e
RANGE ADJUSTMENT PROJECTION LIGHT PATH
RANGE ADJUSTMENT REFLECTED LIGHT PATH
131e(131)
132e(132)
110
Lt
Lr
112
PATTERN GENERATION UNIT
Lt
LIGHT SOURCE
111
IMAGE CAPTURING UNIT
113
20
CONTROL UNIT

FIG. 8

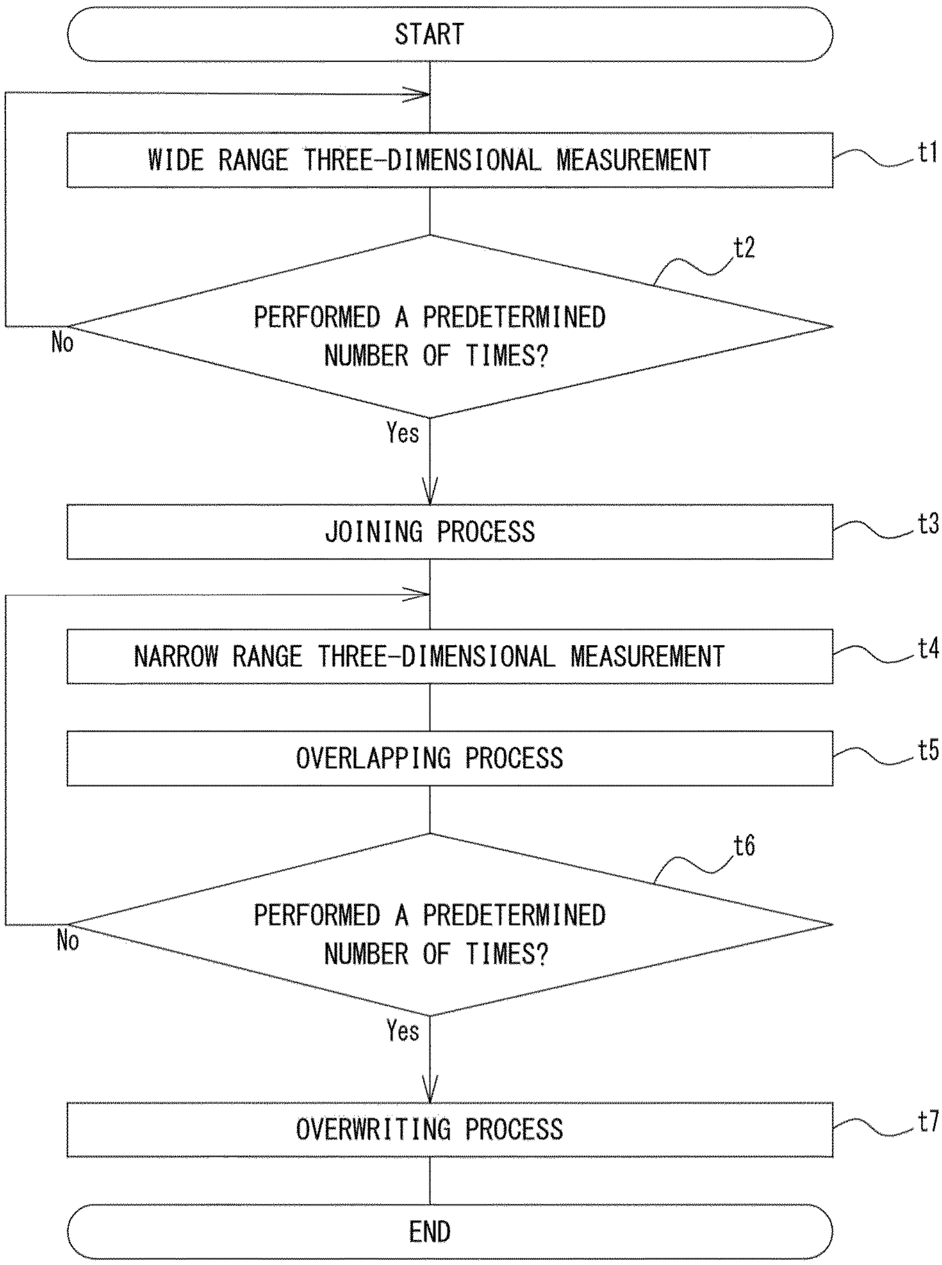

START
WIDE RANGE THREE-DIMENSIONAL MEASUREMENT
t1
PERFORMED A PREDETERMINED NUMBER OF TIMES?
t2
No
Yes
JOINING PROCESS
t3
NARROW RANGE THREE-DIMENSIONAL MEASUREMENT
t4
OVERLAPPING PROCESS
t5
PERFORMED A PREDETERMINED NUMBER OF TIMES?
t6
No
Yes
OVERWRITING PROCESS
t7
END

FIG. 9

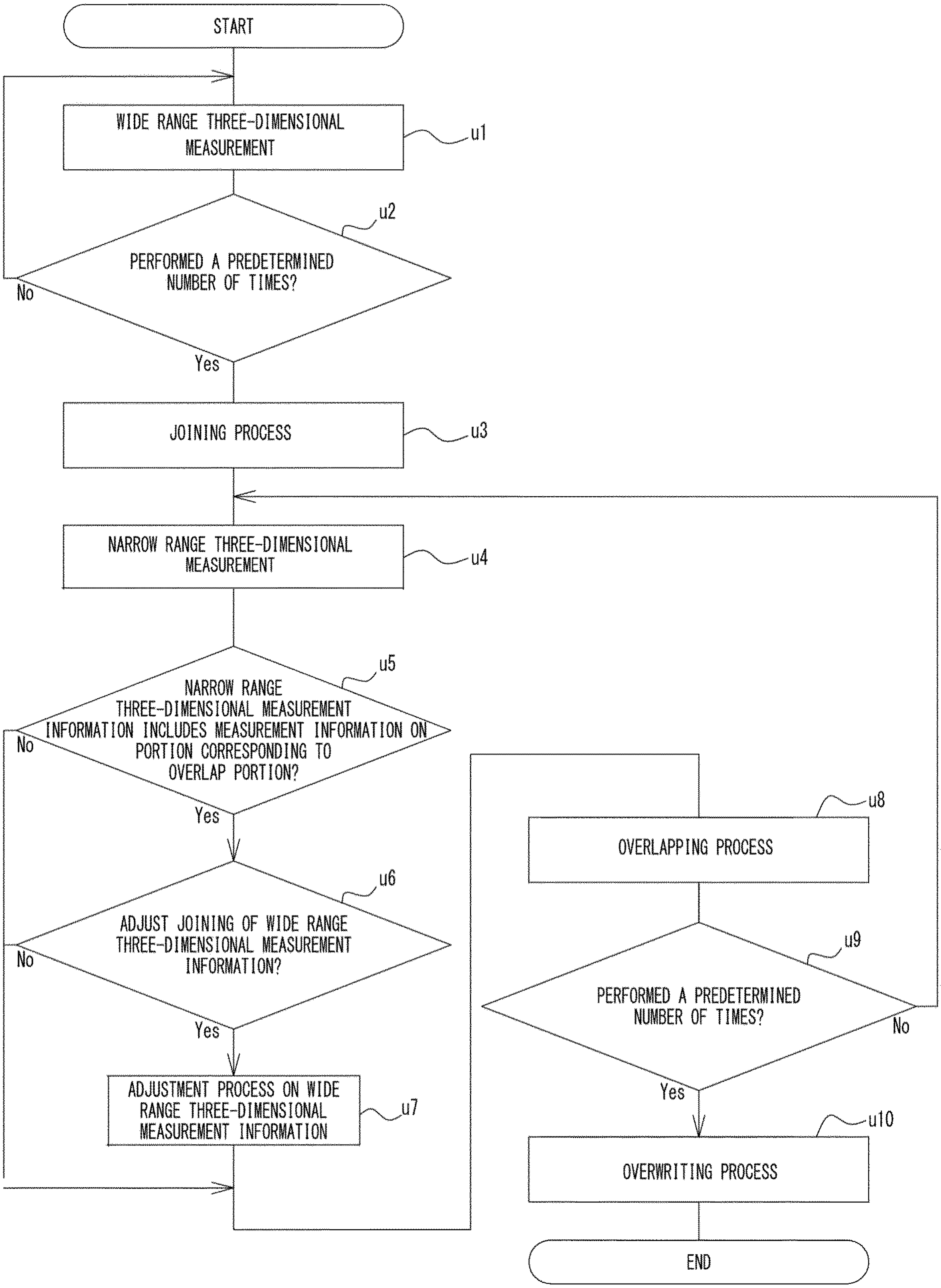

START
WIDE RANGE THREE-DIMENSIONAL MEASUREMENT
u1
PERFORMED A PREDETERMINED NUMBER OF TIMES?
u2
No
Yes
JOINING PROCESS
u3
NARROW RANGE THREE-DIMENSIONAL MEASUREMENT
u4
NARROW RANGE THREE-DIMENSIONAL MEASUREMENT INFORMATION INCLUDES MEASUREMENT INFORMATION ON PORTION CORRESPONDING TO OVERLAP PORTION?
u5
No
Yes
ADJUST JOINING OF WIDE RANGE THREE-DIMENSIONAL MEASUREMENT INFORMATION?
u6
No
Yes
ADJUSTMENT PROCESS ON WIDE RANGE THREE-DIMENSIONAL MEASUREMENT INFORMATION
u7
OVERLAPPING PROCESS
u8
PERFORMED A PREDETERMINED NUMBER OF TIMES?
u9
No
Yes
OVERWRITING PROCESS
u10
END

FIG. 10

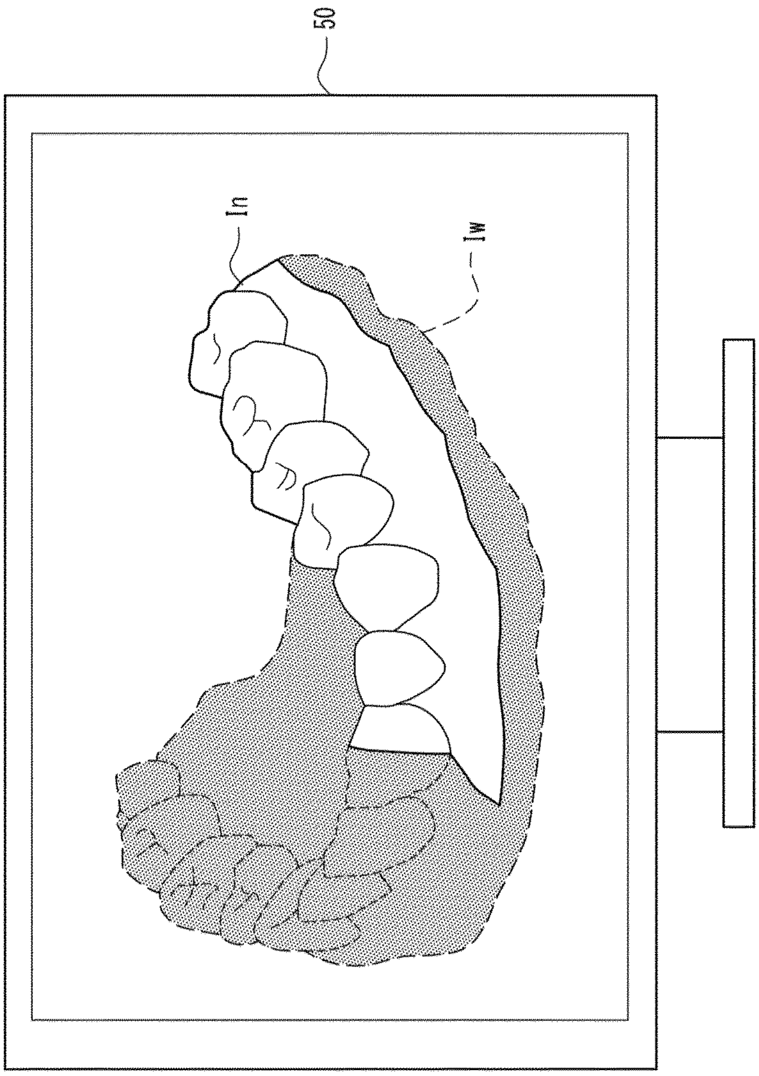
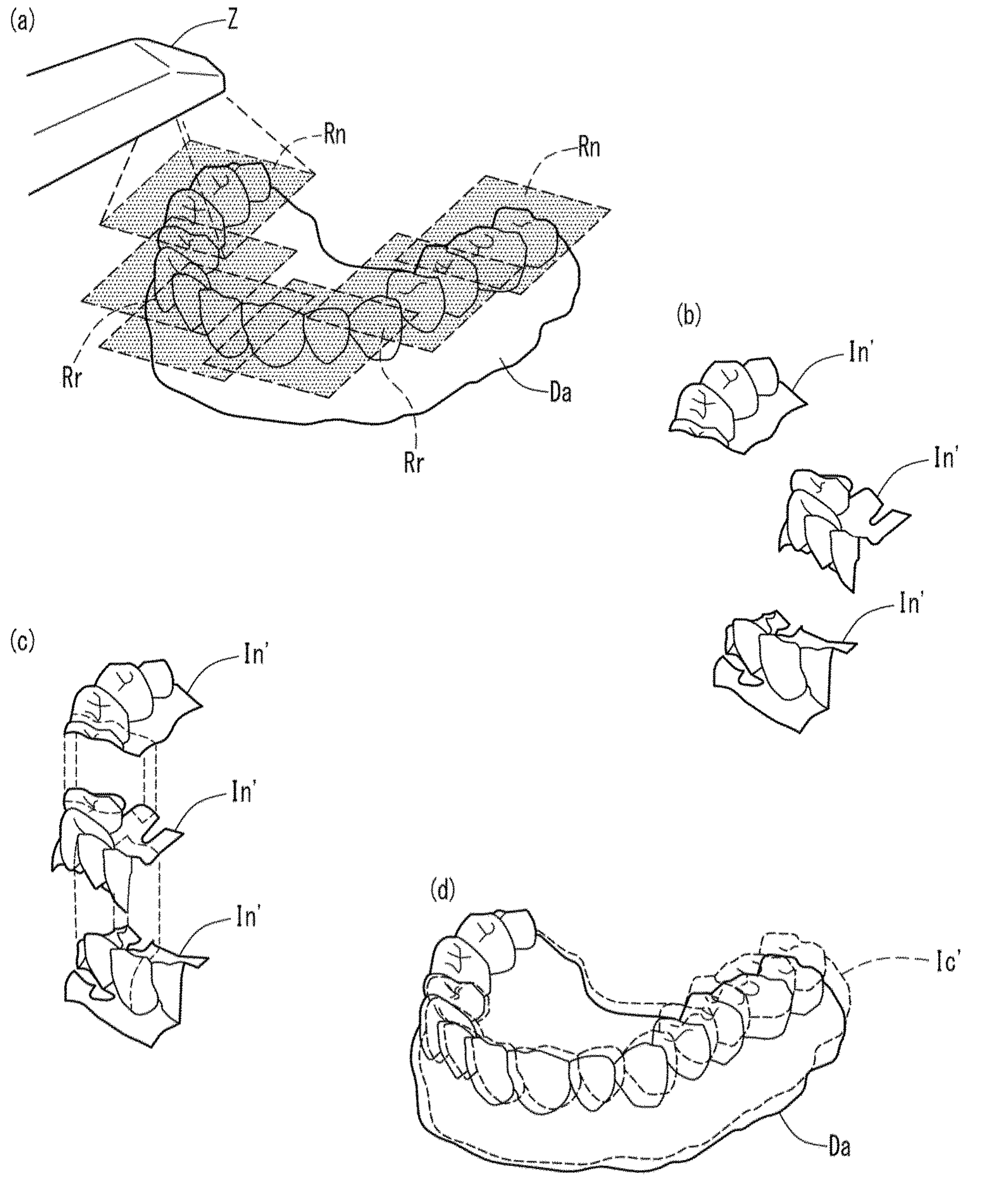


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011242178 A **[0006]**
- US 20140146142 A1 **[0006]**

专利名称(译)	三维内部测量装置，三维内部测量方法和显示三维内部测量结果的方法		
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外部链接	Espacenet		

摘要(译)

口腔内三维测量方法包括广域三维测量信息获取步骤（步骤s1），其获取关于在口腔内的期望测量范围内的大范围内测量的三维形状的广域三维测量信息 空间; 窄范围三维测量信息获取步骤（步骤s2），获取多个窄范围三维测量信息，每条窄范围三维测量信息均以在比测量范围的宽范围窄的窄范围上测量的三维形状进行。 合成三维信息创建步骤（步骤s3），其通过使用内部测量范围作为合成基准，基于宽范围三维测量信息来定位多条窄范围三维测量信息。 宽范围三维测量信息和多个窄范围三维测量信息中的每一个共有的位置信息，以创建关于测量范围的合成三维信息。

FIG.1