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GRIPPING DEVICE CONFIGURED FOR GRIPPING AT LEAST ONE SLIDE

Abstract

A gripping device configured for gripping at least one includes: at least one first gripping element including at least one first contact surface for gripping the slide; at least one second gripping element, wherein the second gripping element comprises at least one second contact surface for gripping the slide, wherein the second gripping element further comprises at least two protrusions which respectively extend essentially perpendicular to the second contact surface, wherein the at least two protrusions are located on opposing ends of the second contact surface, wherein the at least two protrusions are configured for centering the slide during gripping the slide via the gripping device; wherein the first gripping element and the second gripping element are linearly movable relative to one another, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element face each other.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a bypass continuation application of International Application PCT/EP2023/081027, filed Nov. 7, 2023, which claims priority to and the benefit of European Patent Application No. 22206135.0, filed in the European Intellectual Property Office on Nov. 8, 2022, the entire content of each of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a gripping device configured for gripping at least one slide, a slide transfer apparatus, a method for gripping at least one slide, a method for releasing at least one slide, a method for transferring at least one slide from at least one storage device to at least one receiving device and to a method for imaging a plurality of slides. Herein, the slide imaging apparatus can, preferably be used in digital pathology; however, further uses are feasible.

BACKGROUND ART

[0003] A slide imaging apparatus comprises an imaging device which is configured to generate an image of a sample mounted on a slide. The image generated by a modern imaging device is, typically, a digital image, and such an image may, therefore, be referred to as a “digital slide”. Typically, the sample mounted on the slide is a biological specimen, such as a tissue sample. Typically the slide is a glass slide. Typically, a slide imaging apparatus is used in digital pathology, which can be understood as an image-based information environment that enables management of information generated from a digital slide.

[0004] Where an imaging device is capable of generating an image which may cover a majority or a complete surface of a slide, e.g. by using a scanning process, the corresponding slide imaging apparatus may be referred to as a “whole slide imaging” apparatus. A slide imaging apparatus may use a 2D (two-dimensional) camera or a line scan detector to generate the image of a sample mounted on a slide. Examples of a slide imaging apparatus are, for example, described in EP 0 053 4247 B1, EP 0 245 089 A2, U.S. Pat. No. 6,118,582 A, U.S. Pat. No. 6,522,774 B1, U.S. Pat. No. 6,640,014 B1, U.S. Pat. No. 6,711,283 B1, U.S. Pat. No. 7,682,573 B1, WO 2013/017855, U.S. Pat. No. 8,712,116 B2 and U.S. Pat. No. 9,116,035 B2.

[0005] In general, an imaging device has a capacity of processing between 1 and 1,000 slides simultaneously. Typically, a distinction can be made between an imaging device having a low throughput, which relates to a simultaneous processing of less than 10 slides, and an imaging device having a high throughput, which refers to the simultaneous processing of more than 100 slides, wherein an imaging device configured to simultaneously process 10 to 100 slides could, thus, be denoted as an imaging device having a moderate throughput. In order to charge the imaging device with one or more slides, individual slides are, typically, inserted in a manual fashion into a slide repository, particularly selected from a slide tray or a slide rack, which is, subsequently, introduced into the imaging device for generating the desired image of a sample mounted on a slide.

[0006] However, it would be desirable to be able to insert a slide into a slide reception comprised by an imaging device in an automated fashion, in particular by using an adapted supply device. For this purpose, the supply device can be or comprise a gripping device which is, typically, designed for carrying out a specific gripping task. With respect to the disclosure herein, the specific gripping task, particularly, comprises transferring the slide to the slide reception of the imaging device in a tight fashion, thereby avoiding an instability or a loss of the slide during transport.

[0007] WO 2021/191410 A1 describes a slide imaging apparatus and a method for imaging a plurality of slides. The slide imaging apparatus comprises at least one imaging device configured to generate an image of a sample mounted on a slide. The imaging device comprises at least one operating button. Further, the slide imaging apparatus comprises a storage device loadable with a plurality of slides and configured to store the slides. Further, the slide imaging apparatus comprises a supply device configured to supply the slides from the storage device to the imaging device. The supply device is configured to press the operating button.

[0008] EP 3 308 129 A1 describes a machinery for the preparation and the analysis of one or more slides according to an immunofluorescence technique. The machinery comprises a loading station suitable for the arrangement of one or more containers for the containment of test liquids and/or samples of product. Further, the machinery comprises a positioning station of one or more slides. Further, the machinery comprises a containment station of one or more slide-covers. Further, the machinery comprises an analysis station comprising a microscope for the digital acquisition of the images at one or more magnifications. Further, the machinery comprises an assembly mobile inside the area defined by said machinery and controlled in such a way as to move through said stations so as to prepare one or more slides in accordance with a predefined protocol and arrange said slide/s in the corresponding analysis station for a subsequent acquisition of one or more digital images. Further, the machinery comprises one or more covers of such a size as to be applied to cover each slide arranged in the seat. Further, the machinery comprises a container for the containment of one or more of said covers. The assembly is further controlled to operate the removal of the cover/s, once the phase of pre-dilution of the samples has been completed, and arrange it/them inside the container.

[0009] US 2007/059205 A1 describes an automated micro-well plate handling device for removing a micro-well plate from within a vertically stacked plurality of micro-well plates and transferring the removable micro-well plate to a receiving area. A vertical storage device for storing the vertically stacked plurality of micro-well plates creates a vertical clearance space between the vertically stacked micro-well plates. A shovel slides into the vertical clearance space underneath the micro-well plate that is being removed. The shovel then removes the micro-well plate from the vertical storage device and places the micro-well plate at a transfer station. A gripper then grabs the micro-well plate from the transfer station and transfers the micro-well plate to a receiving area. In a preferred embodiment, the automated micro-well plate handling device is controlled via a computer network.

[0010] WO 2012/040433 A1 describes that pathology specimen slides are positively located on trays, and picked and placed by an auto-loader. The trays are received in a rack in tiers accessed by an auto-loader that moves the slides between the trays and a digital imaging microscope. The trays can have rows of receptacles for slides with standoff structures spacing the slides above a tray bottom. Lateral and endwise partitions defining the receptacles are inclined oppositely inwardly for guiding a slide into the predetermined position on the tray. The autoloader has a manipulator that grasps the ends of slides presented in a front row, and can reach over the front row to grasp slides in one or more rows beyond the front. The manipulator lifts the slide between the inclined surfaces of the partitions, loads and later retrieves the slide from the microscope and replaces the slide in the holder.

[0011] CN 110482219 A describes a medical glass slide transferring system and method based on a machine vision. The system involves a mechanical arm, a moving vehicle and a visual positioning

module, wherein the mechanical arm is arranged on the moving vehicle, the visual positioning module is in communication with the mechanical arm, the mechanical arm is in communication with the mobile vehicle, the mobile vehicle drives the mechanical arm to move to a first position, the visual positioning module is used for collecting the position information of a glass slide disc and transmitting the collected position information to the mechanical arm, and the mechanical arm realizes clamping of the glass slide disc according to the received position information.

[0012] WO 2022/123944 A1 describes a microscope slide conveying device comprising: an arm member provided movably in a first direction in a plane and having, at the tip thereof, a first contact member that comes into contact with a first end surface of a microscope slide; a supporting plate having a second contact member that comes into contact with a second end surface opposite the first end surface of the microscope slide in the first direction, and being for supporting the microscope slide from below; a driving part for driving the arm member movably in the first direction; and an impelling member provided between the driving part and the arm member, wherein when the arm member has moved to a position such that the first contact member and the second contact member are in contact with the microscope slide simultaneously, the impelling member impels the arm member in the first direction.

[0013] US 2010/0303600 A1 describes a device for mechanically seizing and setting down impact-sensitive sheets of various formats on at least one stack assembly, ready for dispatch, said device having the following features: a) a control device in the form of a multi-axis robotic arm is connected to a gripper device and means for mechanically gripping the sheets; b) the gripper device is hinged onto and suspended from the control device at a gentle incline by means of an adjustable damping device; c) the gripper device has sliding sections for the relative displacement of the means for mechanically gripping the sheets; d) the gripper device has means for determining the geometric dimensions of the sheets to be seized and for determining their set-down position; e) the gripper device has means for determining the exact positional co-ordinates of the set-down position; f) the gripper device has means for gently feeding and depositing the sheets in the set-down position.

[0014] US 2004/086368 A1 describes grasping mechanisms, gripper apparatus/systems, and related methods. Grasping mechanisms that include stops, support surfaces, and height adjusting surfaces to determine three translational axis positions of a grasped object are provided. In addition, grasping mechanisms that are resiliently coupled to other gripper apparatus components are also described.

[0015] US 2012/002277 A1 describes a slide glass storage device including: a supply tray which has a supply holding space determined by a longer edge upper limit allowed for a longer edge of a slide glass and a shorter edge upper limit allowed for a shorter edge of the slide glass and on which a slide glass to be supplied to a treatment unit operable to perform a predetermined treatment is mounted; a discharge tray which has a discharge holding space determined by a longer edge longer than the longer edge upper limit and a shorter edge longer than the shorter edge upper limit and on which a slide glass having been subjected to the treatment in the treatment unit and being to be discharged is mounted; and a support unit supporting the supply tray and the discharge tray.

[0016] JP 2017 021275 A describes an image acquisition device acquiring image data of a slide is provided that comprises: a first imaging part; a first holding mechanism; a second imaging part which has a second holding mechanism and images a slide held by the second holding mechanism; a slide storing part which stores a plurality of slides; and a control part. The first holding mechanism takes out the slide from the slide storing part, and conveys the slide to a predetermined position of the first imaging part. The first imaging part images the slide held by the first holding mechanism, and the first holding mechanism conveys the slide to the second holding mechanism. The second holding mechanism adjusts a position of the slide, and the second imaging part images the slide held by the second holding mechanism.

[0017] CN 112 269 029 A describes a manipulator convenient for grabbing a slide. The

manipulator comprises a rack, a mounting block, an upper clamping block, a lower clamping block, an elastic clamping piece and an anti-corrosion and anti-skid sheet, wherein the upper clamping block and the lower clamping block are connected with the mounting block; the elastic clamping piece is connected with the upper clamping block, and the lower end of the elastic clamping piece protrudes out of the lower end of the upper clamping block; and the anti-corrosion and anti-skid sheet is arranged at the upper end of the lower clamping block. When the slide is grabbed, the mounting block vertically and horizontally moves relative to the rack, the upper clamping block and the lower clamping block move oppositely or reversely to clamp or loosen the slide, and the lower end of the elastic clamping piece is in elastic contact with the slide, so that the slide can be firmly grabbed, and damage to the slide due to overlarge grabbing force can be avoided; and the anti-corrosion and anti-skid sheet can prevent the slide from sliding off from the lower clamping block and prevent the lower clamping block from being corroded.

[0018] Despite the advantages achieved by the known methods and devices several technical challenges remain. Specifically, a grip may loosen during transport of the slide. Further, in in slide trays there may be limited space for gripping the slide.

Problem to be Solved

[0019] It is, therefore, desirable to provide a gripping device configured for gripping at least one slide, a slide transfer apparatus, a method for gripping at least one slide, a method for releasing at least one slide, a method for transferring at least one slide from at least one storage device to at least one receiving device and a method for imaging a plurality of slides which allow a reliable transfer of the slides.

SUMMARY

[0020] The aforementioned problem is addressed by a gripping device configured for gripping at least one slide, a slide transfer apparatus, a method for gripping at least one slide, a method for releasing at least one slide, a method for transferring at least one slide from at least one storage device to at least one receiving device and a method for imaging a plurality of slides with the features of the independent claims. Advantageous embodiments which might be realized in an isolated fashion or in any arbitrary combinations are listed in the dependent claims.

[0021] As used in the following, the terms “have”, “comprise” or “include” or any arbitrary grammatical variations thereof are used in a non-exclusive way. Thus, these terms may both refer to a situation in which, besides the feature introduced by these terms, no further features are present in the entity described in this context and to a situation in which one or more further features are present. As an example, the expressions “A has B”, “A comprises B” and “A includes B” may both refer to a situation in which, besides B, no other element is present in A (i.e. a situation in which A solely and exclusively consists of B) and to a situation in which, besides B, one or more further elements are present in entity A, such as element C, elements C and D or even further elements.

[0022] Further, it shall be noted that the terms “at least one”, “one or more” or similar expressions indicating that a feature or element may be present once or more than once typically will be used only once when introducing the respective feature or element. In the following, in most cases, when referring to the respective feature or element, the expressions “at least one” or “one or more” will not be repeated, notwithstanding the fact that the respective feature or element may be present once or more than once.

[0023] Further, as used in the following, the terms “preferably”, “more preferably”, “particularly”, “more particularly”, “specifically”, “more specifically” or similar terms are used in conjunction with optional features, without restricting alternative possibilities. Thus, features introduced by these terms are optional features and are not intended to restrict the scope of the claims in any way. The invention may, as the skilled person will recognize, be performed by using alternative features. Similarly, features introduced by “in an embodiment of the invention” or similar expressions are intended to be optional features, without any restriction regarding alternative embodiments of the invention, without any restrictions regarding the scope of the invention and without any restriction

regarding the possibility of combining the features introduced in such way with other optional or non-optional features of the invention.

[0024] The terms “first” and “second” may be considered as nomenclature only, without numbering or ranking the named elements, without specifying an order and without excluding a possibility that several kinds of first elements or second elements may be present. Further, additional elements such as one or more third elements may be present.

[0025] The term “slide” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a substrate which is designated for a sample to be mounted on a surface of the slide. The term “sample” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a biological specimen, such as a tissue sample. However, other kinds of samples may also be feasible.

[0026] In particular for a purpose of carrying the sample without any changes during the processing to the slide, the substrate is mechanically stable and can, therefore, comprise any material which provides sufficient mechanical stability. In particular for a purpose of carrying a biological specimen, the substrate may preferably exhibit a surface which is configured to be compatible with biological material. By way of example, the slide is a glass slide since glass is known, on one hand, to provide sufficient mechanical stability and, on the other hand, to have a high compatibility with biological material. However, further kinds of materials for the slides may also be feasible.

[0027] Further, the slide may, in particular, have a form which may enable imaging of the sample mounted on the slide. For a purpose of generating a desired image of the sample, the slide may, preferably, be a plate having a 2D extension and a thickness, wherein the 2D extension of the plate may, preferably, exhibit a rectangular or circular form, and wherein the thickness of the plate may be small compared to a size of the extension, preferably 20%, more preferred 10 25%, in particular 5%, or less than a measure for a linear extent of the 2D extension of the plate. Further, the slide may comprise at least one spring leaf, specifically at least one plastic spring leaf, configured for interacting with a gripping device which will further be described below in more detail.

[0028] Exemplarily, the slide may have a length of 76 mm, a width of 25 mm and a thickness of 1 mm. However, also other dimensions may be feasible.

[0029] The slide, specifically a plurality of slides, may be received in a slide tray such as for storing, sample preparation or imaging. The term “slide tray” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to an element configured to hold at least one slide or a slide holder, in particular during the scanning of the at least one slide in an imaging device. The slide tray may specifically comprise at plurality of receptacles. A receptacle may be configured for receiving one slide, specifically a single slide. The receptacles may respectively comprise a frame configured for holding a slide, specifically for holding a slide in a horizontal orientation.

[0030] In a first aspect of the present invention, a gripping device for gripping at least one slide is disclosed. The gripping device comprises at least one first gripping element. The first gripping element comprises at least one first contact surface for gripping the slide. Further, the gripping device comprises at least one second gripping element. The second gripping element comprises at least one second contact surface for gripping the slide. The second gripping element further comprises at least two protrusions which respectively extend essentially perpendicular to the second contact surface. The at least two protrusions are located on opposing ends of the second contact surface. The at least two protrusions are configured for centering the slide during gripping the slide via the gripping device. The first gripping element and the second gripping element are linearly movable relative to one another. The first contact surface of the first gripping element and

the second contact surface of the second gripping element face each other.

[0031] The term “gripping device” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a mechanical element which is, typically, designed for seizing an object, transferring it to a desired location and to release the object at the desired location. With respect to the disclosure herein, the specific gripping device may, thus, be configured to grip a slide, to transfer it to a slide reception of a device such as to an imaging device in a tight fashion, thereby avoiding an instability or a loss of the slide during transport, and to release it, preferably to a slide tray.

[0032] The term “gripping element” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a component or a part of a gripping device. The component may be handled independently or may be coupled, connectable or integratable in order to fulfill at least one common function. As outlined above, the gripping device comprises the first gripping element and the second gripping element. The first gripping element and the second gripping element may respectively serve as pliers for gripping the slide. Further details on the first gripping element and the second gripping element are given below in more detail.

[0033] As outlined above, the first gripping element comprises the first contact surface and the second gripping element comprises the second contact surface.

[0034] The term “contact surface” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to an arbitrary surface which is configured to get in direct contact with an object, particularly with a surface or part of a surface of the object.

[0035] Therefore, the object may be configured to lie slackly on the contact surface. The first contact surface of the first gripping element and the second contact surface of the second gripping element may be substantially plane.

[0036] The slide may comprise at least one sample surface being configured for receiving at least one sample and at least one opposing rear surface. The first contact surface of the first gripping element may be configured get in contact with the rear surface. The second contact surface of the second gripping element may be configured to get in contact with the sample surface.

[0037] The slide may specifically have a rectangular base shape having two longitudinal sides and two end faces. The slide may be an elongate element extending along a longitudinal axis. The longitudinal sides may extend essentially parallel to the longitudinal axis and the end faces may extend perpendicular to the longitudinal axis. The gripping device may be configured for gripping the slide on one of the end faces of the slide.

[0038] Specifically, the first contact surface and the second contact surface may respectively be essentially parallel to the sample surface and the opposing rear surface of the slide when the slide is gripped with the gripping device. Thereby, the term “essentially parallel” may refer to a property of first contact surface and the second contact surface of being parallel to the sample surface and the opposing rear surface of the slide. Exemplarily, the first contact surface and the second contact surface may respectively be exactly parallel to the sample surface and the opposing rear surface of the slide. However, small deviations may be feasible. Specifically, the first contact surface and the second contact surface may respectively be arranged at an angle of $\pm 20^\circ$, preferably of $\pm 10^\circ$, more preferably of $\pm 5^\circ$ to sample surface and the opposing rear surface of the slide. The first contact surface and the second contact surface may respectively be in direct contact with only a part of the sample surface and the opposing rear surface of the slide. Thus, a region of the sample surface being covered by the sample may not be in contact with the second contact surface.

[0039] As outlined above, the first gripping element and the second gripping element are linearly

movable relative to one another. Specifically, the first gripping element and the second gripping element may be exclusively linearly movable relative to one another. Exemplarily, the first gripping element may rest while the second part moves. Alternatively, the first gripping element may move and the second gripping element may rest. Moreover, the first gripping element and the second gripping element may move, respectively. The term “linearly moveable” may specifically refer to a property of an element of being designed to provide free motion in one direction, specifically on a straight line. Specifically, it is referred to an element which can be moved on a straight line.

[0040] The first contact surface and the second contact surface may be oriented essentially parallel to each other. Thereby, the term “essentially parallel” may refer to a property of the first contact surface of being parallel to the second contact surface. Exemplarily, the first contact surface may be exactly parallel to the second contact surface. However, small deviations may be feasible.

Specifically, the first contact surface may be arranged at an angle of $\pm 20^\circ$, preferably of $\pm 10^\circ$, more preferably of $\pm 5^\circ$ to the second contact surface. Before gripping the slide with the gripping device, the first contact surface and the second contact surface may be arranged at a distance to each other which is larger than a thickness of the slide, specifically by at least a factor of 2, preferably by at least a factor of 3. When the slide is gripped with the gripping device, the slide may be arranged between the first contact surface and the second contact surface. Thus, the first contact surface and the second contact surface may be arranged in a distance to each other which may be essentially equivalent to a thickness of the slide.

[0041] The first gripping element may be movable in a direction essentially perpendicular to the second contact surface of the second gripping element. The second gripping element may be moveable in a direction essentially perpendicular to the first contact surface of the first gripping element. The term “essentially perpendicular” may comprise slight deviations from a perpendicular arrangement such as arrangements which deviate from a perpendicular arrangement by no more than 10 degrees, preferably by no more than 5 degrees.

[0042] Further, the gripping device may comprise at least one actuator for driving a relative movement of the first gripping element and the second gripping element. As further used herein, the term “actuator” refers to an arbitrary element which is configured to move or control a mechanism or a system. The actuator may be operated by a source of energy, typically electric current or mechanical pressure and may convert energy into motion. The actuator may be selected from the group consisting of: a mechanical actuator, an electromagnetic actuator, a pneumatic actuator. However, other kinds of actuators may be applied.

[0043] The actuator may be configured for performing a predetermined sequence of movements, sequentially bringing the first gripping element and the second gripping element into at least two positions, specifically into a closed position and into an open position. Further, the actuator may be configured for stopping the movement in one of the at least two positions. The open position may refer to a position of the first gripping element and the second gripping element relative to each other wherein the first contact surface and the second contact surface are arranged at a distance to each other which is larger than a thickness of the slide, specifically by at least a factor of 2, preferably by at least a factor of 3.

[0044] The open position may specifically refer to a position before the slide is gripped. The closed position may refer to a position of the first gripping element and the second gripping element relative to each other wherein the first contact surface and the second contact surface are arranged at a distance to each other which is essentially equivalent to a thickness of the slide. In the closed position, the slide may be arranged between the first contact surface and the second contact surface.

[0045] As outlined above, the first contact surface of the first gripping element and the second contact surface of the second gripping element face each other. The first contact surface and the second contact surface may be arranged opposite to each other. As will be outlined in further detail below, the first contact surface and the second contact surface may be shaped differently. Thus, the first contact surface and the second contact surface may be arranged opposite to each other with

offset.

[0046] The first contact surface of the first gripping element may have a rectangular base shape. Specifically, the first contact surface may have a rectangular shape. The term “rectangular base shape” generally refers to an arbitrary shape, wherein at least parts of the shape may be rectangular. However, the shape may at the same time also comprise further characteristics such as, exemplarily, rounded corners. The first contact surface of the first gripping element may have a length and a width. The length may exceed the width by at least a factor of 1.5, preferably by a factor of at least 2, most preferably by a factor of at least 2.5. Exemplarily, the first contact surface may have a length of 8 mm to 20 mm, preferably of 10 mm to 17 mm and most preferably of 14 mm. Further, exemplarily, the first contact surface may have a width of 2 mm to 10 mm, preferably of 4 mm to 6 mm and most preferably of 5 mm. Exemplarily, the first contact surface may have a length of 14 mm and a width of 5 mm. However, also other dimensions may be feasible.

[0047] The first gripping element may comprise at least one first contact component having the first contact surface and at least one first guiding component being configured for guiding the first contact component. The first contact component and the first guiding component may be attached to each other, preferably materially bonded. The first contact component and the first guiding component may be manufactured as one single piece. The first contact component may be rigidly connected to the first guiding component. Thus, a movement of the first contact component relative to the first guiding component such as a rotational movement or a translational movement may not be possible.

[0048] The term “component” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term specifically may refer, without limitation, to a part or an area of an arbitrary object.

[0049] As further used herein, the term “guiding element” is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term specifically may refer, without limitation, to an arbitrary element which is configured to support a movement of an element within a desired direction. The first guiding component may be configured for attachment to at least one actuator configured for enabling a linear movement of the first gripping element.

[0050] As further used herein, the term “contact element” is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term specifically may refer, without limitation, to an arbitrary element which is configured for getting in direct contact with another object. Thus, the contact element may have at least one contact surface which may serve as supporting surface for the object.

[0051] The first guiding component may be an elongate element and the first contact surface may be arranged essentially perpendicular to a longitudinal axis of the first guiding component. The term “essentially perpendicular” may comprise slight deviations from a perpendicular arrangement such as arrangements which deviate from a perpendicular arrangement by no more than 10 degrees, preferably by no more than 5 degrees.

[0052] The first gripping device may have an L-shape. The first guiding component may correspond to a longer arm of the L, which may also be referred to as vertical arm of the L. The first contact component may correspond to a short arm of the L, which may specifically also be referred to as horizontal arm of the L. The first gripping device may have the L-shape in a side view. In the side view, a longer side of the contact surface having the rectangular base shape may extend along an axis of extension of the short arm of the L. Further, in the side view, a shorter side of the contact surface having the rectangular base shape may extend essentially perpendicular to the axis of extension of the short arm of the L.

[0053] The first contact component may comprise at least one surface opposing the first contact surface. The surface may also be referred to as rear surface. The surface may be arranged at an

angle smaller than 90° to the longitudinal axis of the first guiding component. The surface may specifically be arranged at an angle of 80° to 89° to the longitudinal axis of the first guiding component. Thus, a guiding of the first contact component below a slide in a slide tray may be facilitated.

[0054] The first guiding component may comprise at least one hole, specifically at least one drill hole. The hole may extend along the longitudinal axis of the first guiding component. The hole may extend along at least 20%, preferably along at least 30% and most preferably along at least 40% of a length of the first guiding component. Further, a diameter of the hole may correspond to at least 20%, preferably to at least 30% and most preferably to at least 40% of a mean diameter of the first guiding component. The hole may be configured for stiffening of the first guiding element.

[0055] The first contact component may comprise at least one first end and at least one second end. The first guiding component may be attached to the first contact component on the second end. A thickness of the first contact component may gradually decrease from the second end to the first end. A connecting area between the first contact component and the first guiding component may comprise at least one rounded corner. Thus, a guiding of the first contact component below a slide in a slide tray may be facilitated.

[0056] The first gripping element may comprise at least one further contact surface. The further contact surface may be a surface of the first guiding component. The further contact surface may be arranged essentially perpendicular to the first contact surface. The term “essentially perpendicular” may comprise slight deviations from a perpendicular arrangement such as arrangements which deviate from a perpendicular arrangement by no more than 10 degrees, preferably by no more than 5 degrees. The further contact surface may be configured for providing a counterforce for the slide. The first guiding component may be tapered in an area of the further contact surface.

[0057] The second contact surface may extend in a plane being defined by an axis x and an axis y which are arranged perpendicular to each other. The second contact surface may comprise at least one first area and at least one second area. The first area and the second area may respectively have different lengths along the axis x and the axis y. The first area and the second area may respectively have an essentially rectangular shape. The first area and the second area may seamlessly merge into each other. The first area and the second area may extend along the same plane. The second area may be centered aligned to the first area. The second area may be configured for distributing a holding force on the slide.

[0058] The second contact surface may essentially have a T-shape. The first area may correspond to a horizontal arm of the T. The second area may correspond to a vertical arm of the T.

[0059] The first area may have a length $l_{\text{sub.11}}$ along the axis x and a length $l_{\text{sub.12}}$ along the axis y and the second area may have a length $l_{\text{sub.21}}$ along the axis x and a length $l_{\text{sub.22}}$ along the axis y. The length $l_{\text{sub.21}}$ may be larger than the length $l_{\text{sub.11}}$, specifically by at least a factor of 1.5, preferably by at least a factor of 1.7, most preferably by at least a factor of 1.9. The length $l_{\text{sub.12}}$ may be larger than the length $l_{\text{sub.22}}$, specifically by at least a factor of 2, preferably by at least a factor of 3, most preferably by at least a factor of 5. The length $l_{\text{sub.12}}$ may be larger than the length $l_{\text{sub.11}}$, specifically by at least a factor of 2, preferably by at least a factor of 3, most preferably by at least a factor of 3.5. The length $l_{\text{sub.21}}$ may be larger than the length $l_{\text{sub.22}}$, specifically by at least a factor of 1.5, preferably by at least a factor of 2, most preferably by at least a factor of 2.5. The length $l_{\text{sub.12}}$ may be essentially equal to a width of the slide.

Exemplarily, the length $l_{\text{sub.11}}$ may be 3 mm to 15 mm, preferably 5 mm to 10 mm and most preferably 6 mm. Further, exemplarily, the length $l_{\text{sub.12}}$ may be 25 mm to 27 mm, preferably 25.1 mm to 25.8 mm and most preferably 25.5 mm. Further, exemplarily, the length $l_{\text{sub.21}}$ may be 5 mm to 20 mm, preferably 8 mm to 15 mm and most preferably 10 mm. Further, exemplarily, the length $l_{\text{sub.22}}$ may be 2 mm to 10 mm, preferably 4 mm to 6 mm and most preferably 5 mm. Exemplarily, the length $l_{\text{sub.11}}$ may be 6 mm, the length $l_{\text{sub.12}}$ may be 25.5 mm, the length $l_{\text{sub.21}}$ may be 10 mm and the length $l_{\text{sub.22}}$ may be 5 mm. However, also other dimensions may

be feasible.

[0060] As outlined above, the first contact surface of the first gripping element may have a rectangular basic shape with a length and a width. The length may be larger than the width. A longer side of the first contact surface of the first gripping element may extend along the axis x. The longer side of the first contact surface of the first gripping element may extend essentially parallel to a side of the first area having the length $l_{sub.11}$ and essentially parallel to a side of the second area having the length $l_{sub.21}$. A shorter side of the first contact surface of the first gripping element may extend along the axis y. The shorter side of the first contact surface of the first gripping element may extend essentially parallel to a side of the first area having the length $l_{sub.12}$ and essentially parallel to a side of the second area having the length $l_{sub.22}$. When the slide is gripped by the gripping device and arranged between the first contact surface and the second contact surface, a longer side of the slide may extend along the axis x. The longer side of the slide may extend essentially parallel to a side of the first area having the length $l_{sub.11}$, essentially parallel to a side of the second area having the length $l_{sub.21}$ and essentially parallel to the longer side of the first contact surface of the first gripping element. Further, when the slide is gripped by the gripping device and arranged between the first contact surface and the second contact surface, a longer side of the slide may extend along the axis x. The longer side of the slide may extend essentially parallel to the side of the first area having the length $l_{sub.12}$, essentially parallel to a side of the second area having the length $l_{sub.22}$ and essentially parallel to the shorter side of the first contact surface of the first gripping element.

[0061] The second gripping element may comprise at least one second contact component having the second contact surface and at least one second guiding component being configured for guiding the second contact component.

[0062] Concerning the terms “contact component” and “guiding component” reference is made to the description above. The second contact component and the second guiding component may be attached to each other, preferably materially bonded. The second contact component and the second guiding component may be manufactured as one single piece. The second contact component may be rigidly connected to the second guiding component. Thus, a movement of the second contact component relative to the second guiding component such as a rotational movement or a translational movement may not be possible.

[0063] The second guiding component may be configured for attachment to at least one actuator configured for enabling a linear movement of the second gripping element.

[0064] The second guiding component may be an elongate element. The second guiding element may comprise at least one first end and at least one opposing second end and the second contact surface may be arranged at the first end of the second guiding element. The second guiding component may taper from the first end to the second end.

[0065] The second contact surface may be arranged essentially perpendicular to a longitudinal axis of the second guiding component. The term “essentially perpendicular” may comprise slight deviations from a perpendicular arrangement such as arrangements which deviate from a perpendicular arrangement by no more than 10 degrees, preferably by no more than 5 degrees.

[0066] As outlined above, the second gripping element comprises at least two protrusions which respectively extend essentially perpendicular to the second contact surface. Specifically, the second gripping element comprises two protrusions which respectively extend essentially perpendicular to the second contact surface. The at least two protrusions are located on opposing ends of the second contact surface. The at least two protrusions are configured for centering the slide during gripping the slide via the gripping device. The term “protrusion” as used herein is a broad term and is to be given its ordinary and custom-ary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term specifically may refer, without limitation, to at least one element protruding outwards at least one surface of an element, in particular perpendicular to the surface of the element. The term “essentially perpendicular” may comprise

slight deviations from a perpendicular arrangement such as arrangements which deviate from a perpendicular arrangement by no more than 10 degrees, preferably by no more than 5 degrees. [0067] The protrusions may respectively have a rectangular base shape. The term “rectangular base shape” generally refers to an arbitrary shape, wherein at least parts of the shape may be rectangular. However, the shape may at the same time also comprise further characteristics such as, exemplarily, rounded corners. The protrusions may respectively have a first length and a second length. The first length may specifically correspond to the length l.sub.11 of the first area. Exemplarily, the first length may be 3 mm to 15 mm, preferably 5 mm to 10 mm and most preferably 6 mm. Further, exemplarily, the second length may be 1 mm to 5 mm, preferably 2 mm to 4 mm and most preferably 3 mm. Exemplarily, the first length may be 6 mm and the second length may be 3 mm. However, also other dimensions may be feasible.

[0068] A distance between the at least two protrusions may be essentially equal to a width of the slide. The term “essentially equal” may refer to a distance between the at least two protrusions equal to the width of the slide. Further, the term may refer to a distance between the at least two protrusions slightly larger than the width of the slide.

[0069] The at least two protrusions may be located on opposing ends of the first area of the second contact surface. A length of the protrusions may correspond to the length l.sub.11 of the first area. The protrusions may extend along an axis z being perpendicular to the axis x and the axis y.

[0070] The first guiding component of the first gripping element and the second guiding component of the second gripping element may be arranged parallel to each other. The first guiding component and the second guiding component may be arranged in a distance to each other. The first guiding component and the second guiding component may both extend in a same direction. The first guiding component and the second guiding component may respectively extend along the axis z. The second area of the second contact surface of the second gripping element may be arranged between the first guiding element and the first area of the second contact surface of the second gripping element.

[0071] In a second aspect of the present invention, a slide transfer apparatus is disclosed. The slide transfer apparatus comprises at least one storage device. The storage device is loadable with a plurality of slides and configured to store the slides. Further, the slide transfer apparatus comprises at least one receiving device. The receiving device is configured to receive slides transferred from the storage device. Further, the slide transfer apparatus comprises at least one transfer device. The transfer device is configured to transfer the slides from the storage device to the receiving device. The transfer device comprises at least one robotic arm. At least one gripping device as described above or as will further be described below in more detail is arranged at the robotic arm. The gripping device may specifically be arranged at the robotic arm by mounting the gripping device to the robotic arm or by forming the gripping device at the robotic arm.

[0072] The term “apparatus” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a device having a plurality of components as disclosed below in more detail. The term “slide transfer apparatus” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to an arbitrary apparatus which is configured for an active transportation of an arbitrary slide from one location to another location or vice versa.

[0073] The terms “storage device” and “receiving device” as used herein are broad terms and are to be given their ordinary and customary meanings to a person of ordinary skill in the art and are not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a slide repository which is designated for receiving an individual slide holder or, alternatively, more than one slide holder simultaneously, wherein each slide holder is configured to hold more than one slide. In a preferred embodiment, the storage device may comprise at least two

compartments, wherein each of the compartments is configured to store a portion of the slides. Herein, the compartments may comprise at least two rows which are placed in an adjacent manner, thus, storing the slides next to one another. In particular, the storage device may be selected from a slide tray or a slide rack, however, further types of storage devices may also be feasible. However, further kinds of arrangements of the slides and/or the slide holders, respectively, in the storage device may also be feasible. Thus, the storage device may be loadable with the plurality of slides, preferably, in a manual fashion, wherein, however, an automatic loading of the storage device may also be conceivable.

[0074] The term “transfer device” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a device which is configured to transfer the slides from the storage device to the at least one receiving device. For this purpose, the transfer device comprises the robotic arm.

[0075] Herein, the term “robotic arm” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a programmable mechanical unit having a form of at least one of a hand or an arm and configured to move in a similar manner as the hand or the arm, using an electrical and/or pneumatic drive, including but not limited to gripping at least one object, in particular a slide or a slide holder, and transferring it to a defined destination. The robotic arm may be a multi-axis robotic arm. Thus, the robotic arm may be configured for moving the gripping device in linear direction along the axis x, the axis y and the axis z. Further, the robotic arm may be configured for performing tilting movements of the gripping device.

[0076] The transfer of the slides from the storage device to the at least one receiving device is, preferably, performed in an automated fashion. The terms “in an automated fashion” and “automatedly” as used herein are broad terms and are to be given their ordinary and customary meaning to a person of ordinary skill in the art and are not to be limited to a special or customized meaning. The terms may, specifically, refer, without limitation, to a kind of process which is performed without direct interaction of a user of the slide transfer apparatus on a basis of an algorithm configured to perform the transfer of the slides without manual performance of the user.

[0077] In a third aspect of the present invention, a slide imaging apparatus is disclosed. The slide imaging apparatus comprises at least one slide transfer apparatus as described above or as will further be described below in more detail. Further, the slide imaging apparatus comprises at least one imaging device configured to generate an image of a sample mounted on a slide. The imaging device may be part of the receiving device as described above or may refer to a separate device.

[0078] The terms “imaging” or “generate an image” as used herein are broad terms and are to be given their ordinary and customary meaning to a person of ordinary skill in the art and are not to be limited to a special or customized meaning. The terms may, specifically, refer, without limitation, to providing a 2D two-dimensional representation of at least one property of the sample, also denoted by the term “image”, which can, typically, be processed and displayed on a screen for being regarded by eyes of a viewer, preferably, without any further aids, apart from eyeglasses of the viewer. For this purpose an imaging device as disclosed above in more detail is, typically, used.

[0079] The term “imaging device” as used herein is a broad term and is to be given its ordinary and customary meaning to a person of ordinary skill in the art and is not to be limited to a special or customized meaning. The term may, specifically, refer, without limitation, to a device which is designated for generating a 2D representation of at least one visual property of the sample. In particular, the imaging device may be selected from a 2D camera or a line scan detector.

However, further kinds of imaging devices may also be feasible. Consequently, the slide imaging apparatus according to the present invention may comprise one, two, three, four, five, six, or more individual imaging devices, wherein the at least one individual imaging device can be individually

addressed by the supply device as disclosed below in more detail. Herein, the further imaging devices could, in particular, be maintained as a further backup option in case of failure of more than one imaging device.

[0080] In a fourth aspect of the present invention, a method for gripping at least one slide is disclosed.

[0081] The method comprises the following steps which specifically may be performed in the given order. Further, it is also possible to perform one or more of the method steps once or repeatedly. Further, it is possible to perform two or more of the method steps simultaneously or in a timely overlapping fashion. The method may comprise further method steps which are not listed.

[0082] The method for gripping at least one slide comprises:

providing at least one gripping device as described above or as will further be described below in more detail, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element are arranged in a distance to each other;

moving the gripping device such that the slide is arranged between the first contact surface and the second contact surface; and

gripping the slide via the first contact surface and the second contact surface.

[0083] In step a), the distance between the first contact surface of the first gripping element and the second contact surface of the second gripping element may be larger than a thickness of the slide, specifically by at least a factor of 2, preferably by at least a factor of 3.

[0084] In step b), the gripping device may be moved via the robotic arm. For further details on the robotic arm reference is made to the description above.

[0085] Before performing step b) the first contact surface and the second contact surface may respectively be horizontally aligned and the horizontal alignment may be maintained during performing step b). Thus, in step b), a combination of exclusively horizontal and vertical movements of the first contact surface and the second contact surface may be performed. This scenario may specifically be expedient in case there is enough space for the gripping device to be moved such that the slide is arranged between the first contact surface and the second contact surface. Specifically, there may be enough free space around the end face of the slide.

[0086] Alternatively, in step b), at least one tilting movement of the first contact surface and the second contact surface may be performed. Additionally, horizontal and vertical movements of the first contact surface and the second contact surface may be performed. This scenario may specifically be expedient in case there is only limited space for the gripping device to be moved such that the slide is arranged between the first contact surface and the second contact surface. Specifically, the slide may be arranged in a slide tray and the slide may be received in a receptacle of the slide tray and there may be free space between a frame of the slide tray and one of the end faces of the slide.

[0087] Specifically, step b) may comprise the following steps:

[0088] b1) performing at least one first tilting movement of the gripping device such that the slide is arranged between the first contact surface and the second contact surface; and

[0089] b2) performing at least one second tilting movement of the gripping device such that the first contact surface and the second contact surface are respectively aligned essentially parallel to the slide, specifically to the sample surface of the slide.

[0090] In step b), the first contact surface and the second contact surface may be respectively arranged in a distance to the slide. The distance between the first contact surface and the second contact surface may correspond to a distance between the first contact surface and the second contact surface in step a).

[0091] In step c) the slide may be clamped between the first contact surface and the second contact surface. In step c) the first contact surface and the second contact surface may respectively be or get in direct contact with the slide.

[0092] As outlined above, the first gripping element may comprise the at least one further contact

surface. The further contact surface may be arranged essentially perpendicular to the first contact surface. In step b), the gripping device may be moved such that when the slide is gripped via the first contact surface and the second contact surface in step c) the slide is in direct contact with the further contact surface.

[0093] Alternatively, in step b), the gripping device may be moved such that when the slide is gripped via the first contact surface and the second contact surface in step c) the slide is arranged in a distance to the further contact surface. The distance may specifically be 1 mm to 5 mm, preferably 1.5 mm to 3 mm and most preferably 2 mm. However, also other dimensions may be feasible.

[0094] Thus, after conducting step c), the following steps may be conducted:

[0095] d1) a contact between the second contact surface and the slide is released, specifically by moving the second gripping element;

[0096] d2) the gripping device is moved in a direction towards the slide such that when the slide is gripped again via the first contact surface and the second contact surface the slide is in direct contact with the further contact surface; and

[0097] d3) gripping the slide via the first contact surface and the second contact surface.

[0098] After step c), the slide may be removed from a slide tray via the gripping device.

[0099] In a fifth aspect of the present invention, a method for releasing at least one slide is disclosed.

[0100] The method comprises the following steps which specifically may be performed in the given order. Further, it is also possible to perform one or more of the method steps once or repeatedly. Further, it is possible to perform two or more of the method steps simultaneously or in a timely overlapping fashion. The method may comprise further method steps which are not listed.

[0101] The method for releasing at least one slide comprises the following steps:

[0102] providing at least one gripping device as described above or as will further be described below in more detail, wherein at least one slide is gripped via the first contact surface of the first gripping element and the second contact surface of the second gripping element;

[0103] placing the slide into a receptacle of a slide tray;

[0104] increasing a distance between the first contact surface and the second contact surface, specifically by at least a factor of 2, preferably by at least a factor of 3; and

[0105] removing the gripping device from the slide.

[0106] In steps ii. and iv., the gripping device may be moved via the robotic arm. For further details on the robotic arm reference is made to the description above.

[0107] In step ii., the slide may be placed into the receptacle of the slide tray by a combination of exclusively horizontal and vertical movements of the first contact surface and the second contact surface. Alternatively, in step ii., the slide may be placed into the receptacle of the slide tray by at least one tilting movement of the first contact surface and the second contact surface. Further, in addition to the at least one tilting movement, horizontal and vertical movements of the first contact surface and the second contact surface may be performed.

[0108] In step iv., the gripping device may be removed from the slide by a combination of exclusively horizontal and vertical movements of the first contact surface and the second contact surface. Alternatively, in step iv., the gripping device may be removed from the slide by at least one tilting movement of the first contact surface and the second contact surface. Further, in addition to the at least one tilting movement, horizontal and vertical movements of the first contact surface and the second contact surface may be performed.

[0109] In a sixth aspect of the present invention, a method for transferring at least one slide from at least one storage device to at least one receiving device is disclosed.

[0110] The method comprises the following steps which specifically may be performed in the given order. Further, it is also possible to perform one or more of the method steps once or repeatedly. Further, it is possible to perform two or more of the method steps simultaneously or in a timely

overlapping fashion. The method may comprise further method steps which are not listed.

[0111] The method for transferring at least one slide from at least one storage device to at least one receiving device comprises:

providing the at least one slide in the storage device;

gripping the at least one slide via the method for gripping at least one slide as described above or as will further be described below in more detail;

moving the at least one slide from the storage device to the receiving device; and

releasing the at least one slide via the method for releasing at least one slide as described above or as will further be described below in more detail.

[0112] In in step III., the gripping device may be moved via the robotic arm. For further details on the robotic arm reference is made to the description above.

[0113] In a seventh aspect of the present invention, a method for imaging a plurality of slides is disclosed.

[0114] The method comprises the following steps which specifically may be performed in the given order. Further, it is also possible to perform one or more of the method steps once or repeatedly. Further, it is possible to perform two or more of the method steps simultaneously or in a timely overlapping fashion. The method may comprise further method steps which are not listed.

[0115] The method for imaging a plurality of slides comprises:

[0116] loading a plurality of slides into a storage device and storing the slides in the storage device; transferring the slides from the storage device to a receiving device via the method for transferring at least one slide as described above or as will further be described below in more detail; and generating an image of a sample mounted on the slide using the imaging device.

[0117] Further disclosed and proposed herein is a computer program including computer-executable instructions for performing one or more of the methods according to the present invention in one or more of the embodiments enclosed herein when the program is executed on a computer or computer network. Specifically, the computer program may be stored on a computer-readable data carrier and/or on a computer-readable storage medium.

[0118] Thus, specifically, one, more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps. A. to C. of the method for imaging a plurality of slides as indicated above may be performed by using a computer or a computer network, preferably by using a computer program.

[0119] The invention further discloses and proposes a computer program product having program code means, in order to perform more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps. A. to C. of the method for imaging a plurality of slides as indicated above according to the present invention in one or more of the embodiments enclosed herein when the program is executed on a computer or computer network. Specifically, the program code means may be stored on a computer-readable data carrier.

[0120] Further, the invention discloses and proposes a data carrier having a data structure stored thereon, which, after loading into a computer or computer network, such as into a working memory or main memory of the computer or computer network, may execute more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for

transferring at least one slide from at least one storage device to at least one receiving device, and of method steps. A. to C. of the method for imaging a plurality of slides as indicated above according to one or more of the embodiments disclosed herein.

[0121] The invention further proposes and discloses a computer program product with program code means stored on a machine-readable carrier, in order to perform more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps. A. to C. of the method for imaging a plurality of slides as indicated above according to one or more of the embodiments disclosed herein, when the program is executed on a computer or computer network. As used herein, a computer program product refers to the program as a tradable product. The product may generally exist in an arbitrary format, such as in a paper format, or on a computer-readable data carrier. Specifically, the computer program product may be distributed over a data network.

[0122] Finally, the invention proposes and discloses a modulated data signal which contains instructions readable by a computer system or computer network, for performing more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides as indicated above according to one or more of the embodiments disclosed herein.

[0123] Preferably, referring to the computer-implemented aspects of the invention, more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps. A. to C. of the method for imaging a plurality of slides as indicated above according to one or more of the embodiments disclosed herein may be performed by using a computer or computer network. Thus, generally, any of the method steps including provision and/or manipulation of data may be performed by using a computer or computer network. Generally, these method steps may include any of the method steps, typically except for method steps requiring manual work, such as providing the samples and/or certain aspects of performing the actual measurements.

[0124] Specifically, the present invention further discloses:

[0125] A computer or computer network comprising at least one processor, wherein the processor is adapted to perform more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides according to one of the embodiments described in this description, a computer loadable data structure that is adapted to perform more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides according to one of the embodiments described in this description while the data structure is being executed on a computer,

a computer program, wherein the computer program is adapted to perform more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides according to one of the embodiments described in this description while the program is being executed on a computer,

a computer program comprising program means for performing more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides according to one of the embodiments described in this description while the computer program is being executed on a computer or on a computer network, a computer program comprising program means according to the preceding embodiment, wherein the program means are stored on a storage medium readable to a computer,

a storage medium, wherein a data structure is stored on the storage medium and wherein the data structure is adapted to perform more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides according to one of the embodiments described in this description after having been loaded into a main and/or working storage of a computer or of a computer network, and a computer program product having program code means, wherein the program code means can be stored or are stored on a storage medium, for performing more than one or even all of method steps a) to c), specifically of method steps b) and c), of the method for gripping at least one slide, of method steps i. to iv., specifically of method steps ii. to iv., of the method for releasing at least one slide, of method steps I. to IV., specifically of method steps II. to IV., of the method for transferring at least one slide from at least one storage device to at least one receiving device, and of method steps A. to C. of the method for imaging a plurality of slides according to one of the embodiments described in this description, if the program code means are executed on a computer or on a computer network.

[0126] Summarizing and without excluding further possible embodiments, the following embodiments may be envisaged:

[0127] Embodiment 1: A gripping device configured for gripping at least one slide, wherein the gripping device comprises:

[0128] at least one first gripping element, wherein the first gripping element comprises at least one first contact surface for gripping the slide;

[0129] at least one second gripping element, wherein the second gripping element comprises at least one second contact surface for gripping the slide, wherein the second gripping element further comprises at least two protrusions which respectively extend essentially perpendicular to the second contact surface, wherein the at least two protrusions are located on opposing ends of the second contact surface, wherein the at least two protrusions are configured for centering the slide during gripping the slide via the gripping device;

[0130] wherein the first gripping element and the second gripping element are linearly movable relative to one another, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element face each other.

[0131] Embodiment 2: The gripping device according to the preceding embodiment, wherein the first surface of the first gripping element and the second surface of the second gripping element are substantially plane.

[0132] Embodiment 3: The gripping device according to any one of the preceding embodiments, wherein the slide comprises at least one sample surface being configured for receiving at least one sample and at least one opposing rear surface, wherein the first contact surface of the first gripping element is configured to get in contact with the rear surface, wherein the second contact surface of the second gripping element is configured to get in contact with the sample surface.

[0133] Embodiment 4: The gripping device according to any one of the preceding embodiments, wherein a distance between the at least two protrusions is essentially equal to a width of the slide.

[0134] Embodiment 5: The gripping device according to any one of the preceding embodiments, wherein the first contact surface of the first gripping element has a rectangular base shape.

[0135] Embodiment 6: The gripping device according to any one of the preceding embodiments, wherein the first contact surface of the first gripping element has a length and a width, wherein the length exceeds the width by at least a factor of 1.5, preferably by a factor of at least 2, most preferably by a factor of at least 2.5.

[0136] Embodiment 7: The gripping device according to any one of the preceding embodiments, wherein the first gripping element comprises at least one first contact component having the first contact surface and at least one first guiding component being configured for guiding the first contact component.

[0137] Embodiment 8: The gripping device according to the preceding embodiment, wherein the first contact component and the first guiding component are attached to each other, preferably materially bonded.

[0138] Embodiment 9: The gripping device according to the preceding embodiment, wherein the first contact component and the first guiding component are manufactured as one single piece.

[0139] Embodiment 10: The gripping device according to any one of the three preceding embodiments, wherein the first guiding component is an elongate element, wherein the first contact surface is arranged essentially perpendicular to a longitudinal axis of the first guiding component.

[0140] Embodiment 11: The gripping device according to the preceding embodiment, wherein the first contact component comprises at least one surface opposing the first contact surface, wherein the surface is arranged at an angle smaller than 90° to the longitudinal axis of the first guiding component.

[0141] Embodiment 12: The gripping device according to the preceding embodiment, wherein the surface is arranged at an angle of 80° to 89° to the longitudinal axis of the first guiding component.

[0142] Embodiment 13: The gripping device according to any one of the three preceding embodiments, wherein the first guiding component comprises at least one hole, specifically at least one drill hole, wherein the hole extends along the longitudinal axis of the first guiding component.

[0143] Embodiment 14: The gripping device according to any one of the seven preceding embodiments, wherein the first guiding component is configured for attachment to at least one actuator configured for enabling a linear movement of the first gripping element.

[0144] Embodiment 15: The gripping device according to any one of the eight preceding embodiments, wherein the first contact component comprises at least one first end and at least one second end, wherein the first guiding component is attached to the first contact component on the second end, wherein a thickness of the first contact component gradually decreases from the second end to the first end.

[0145] Embodiment 16: The gripping device according to any one of the nine preceding embodiments, wherein a connecting area between the first contact component and the first guiding component comprises at least one rounded corner.

[0146] Embodiment 17: The gripping device according to any one of the ten preceding embodiments, wherein the first gripping element comprises at least one further contact surface,

wherein the further contact surface is arranged essentially perpendicular to the first contact surface.

[0147] Embodiment 18: The gripping device according to the preceding embodiment, wherein the further contact surface is configured for providing a counterforce for the slide.

[0148] Embodiment 19: The gripping device according to any one of the two preceding embodiments, wherein the further contact surface is a surface of the first guiding component.

[0149] Embodiment 20: The gripping device according to any one of the three preceding embodiments, wherein the first guiding component is tapered in an area of the further contact surface.

[0150] Embodiment 21: The gripping device according to any one of the four preceding embodiments, wherein the first gripping element essentially has an L-shape.

[0151] Embodiment 22: The gripping device according to any one of the preceding embodiments, wherein the second contact surface essentially has a T-shape.

[0152] Embodiment 23: The gripping device according to any one of the preceding embodiments, wherein the second contact surface extends in a plane being defined by an axis x and an axis y which are arranged perpendicular to each other, wherein the second contact surface comprises at least one first area and at least one second area, wherein the first area and the second area respectively have different lengths along the axis x and the axis y.

[0153] Embodiment 24: The gripping device according to the preceding embodiment, wherein the first area and the second area respectively have an essentially rectangular shape.

[0154] Embodiment 25: The gripping device according to any one of the two preceding embodiments, wherein the second area is centered aligned to the first area.

[0155] Embodiment 26: The gripping device according to any one of the three preceding embodiments, wherein the second area is configured for distributing a holding force on the slide.

[0156] Embodiment 27: The gripping device according to any one of the four preceding embodiments, wherein the at least two protrusions are located on opposing ends of the first area.

[0157] Embodiment 28: The gripping device according to any one of the five preceding embodiments, wherein the first area has a length $l_{sub.11}$ along the axis x and a length $l_{sub.12}$ along the axis y, wherein the second area has a length $l_{sub.21}$ along the axis x and a length $l_{sub.22}$ along the axis y.

[0158] Embodiment 29: The gripping device according to the preceding embodiment, wherein the length $l_{sub.21}$ is larger than the length $l_{sub.11}$, specifically by at least a factor of 1.5, preferably by at least a factor of 1.7, most preferably by at least a factor of 1.9.

[0159] Embodiment 30: The gripping device according to any one of the two preceding embodiments, wherein the length $l_{sub.12}$ is larger than the length $l_{sub.22}$, specifically by at least a factor of 2, preferably by at least a factor of 3, most preferably by at least a factor of 5.

[0160] Embodiment 31: The gripping device according to any one of the three preceding embodiments, wherein the length $l_{sub.12}$ is larger than the length $l_{sub.11}$, specifically by at least a factor of 2, preferably by at least a factor of 3, most preferably by at least a factor of 3.5.

[0161] Embodiment 32: The gripping device according to any one of the four preceding embodiments, wherein the length $l_{sub.21}$ is larger than the length $l_{sub.22}$, specifically by at least a factor of 1.5, preferably by at least a factor of 2, most preferably by at least a factor of 2.5.

[0162] Embodiment 33: The gripping device according to any one of the five preceding embodiments, wherein the length $l_{sub.12}$ is essentially equal to a width of the slide.

[0163] Embodiment 34: The gripping device according to any one of the preceding embodiments, wherein the second gripping element comprises at least one second contact component having the second contact surface and at least one second guiding component being configured for guiding the second contact component.

[0164] Embodiment 35: The gripping device according to the preceding embodiment, wherein the second contact component and the second guiding component are attached to each other, preferably materially bonded.

[0165] Embodiment 36: The gripping device according to the preceding embodiment, wherein the second contact component and the second guiding component are manufactured as one single piece.

[0166] Embodiment 37: The gripping device according to any one of the three preceding embodiments, wherein the second guiding component is an elongate element, wherein the second guiding element comprises at least one first end and at least one opposing second end and wherein the second contact surface is arranged at the first end of the second guiding element.

[0167] Embodiment 38: The gripping device according to the preceding embodiment, wherein the second guiding component tapers from the first end to the second end.

[0168] Embodiment 39: The gripping device according to any one of the five preceding embodiments, wherein the second contact surface is arranged essentially perpendicular to a longitudinal axis of the second guiding component.

[0169] Embodiment 40: The gripping device according to any one of the six preceding embodiments, wherein the second guiding component is configured for attachment to at least one actuator configured for enabling a linear movement of the second gripping element.

[0170] Embodiment 41: A slide transfer apparatus, wherein the slide transfer apparatus comprises:
[0171] at least one storage device, wherein the storage device is loadable with a plurality of slides and configured to store the slides;

[0172] at least one receiving device, wherein the receiving device is configured to receive slides transferred from the storage device; and

[0173] at least one transfer device, wherein the transfer device is configured to transfer the slides from the storage device to the receiving device, wherein the transfer device comprises at least one robotic arm, wherein at least one gripping device according to any one of the preceding claims is arranged at the robotic arm.

[0174] Embodiment 42: The slide transfer apparatus according to the preceding embodiment, wherein the robotic arm is a multi-axis robotic arm.

[0175] Embodiment 43: A slide imaging apparatus, wherein the slide imaging apparatus comprises:

[0176] at least one slide transfer apparatus according to any one of the preceding claims; and

[0177] at least one imaging device configured to generate an image of a sample mounted on a slide.

[0178] Embodiment 44: A method for gripping at least one slide, wherein the method comprises:

[0179] providing at least one gripping device according to any one of the preceding claims referring to a gripping device, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element are arranged in a distance to each other;

[0180] moving the gripping device such that the slide is arranged between the first contact surface and the second contact surface; and

[0181] gripping the slide via the first contact surface and the second contact surface.

[0182] Embodiment 45: The method according to the preceding embodiment, wherein in step a) the distance between the first contact surface of the first gripping element and the second contact surface of the second gripping element is larger than a thickness of the slide.

[0183] Embodiment 46: The method according to any one of the two preceding embodiments, wherein before performing step b) the first contact surface and the second contact surface are respectively horizontally aligned and the horizontal alignment is maintained during performing step b).

[0184] Embodiment 47: The method according to any one of the three preceding embodiments, wherein in step b) at least one tilting movement of the first contact surface and the second contact surface is performed.

[0185] Embodiment 48: The method according to the preceding embodiment, wherein step b) comprises the following steps:

[0186] b1) performing at least one first tilting movement of the gripping device such that the slide is arranged between the first contact surface and the second contact surface; and

[0187] b2) performing at least one second tilting movement of the gripping device such that the first contact surface and the second contact surface are respectively aligned essentially parallel to the slide.

[0188] Embodiment 49: The method according to any one of the five preceding embodiments, wherein in step b), the first contact surface and the second contact surface are respectively arranged in a distance to the slide.

[0189] Embodiment 50: The method according to any one of the six preceding embodiments, wherein in step c) the first contact surface and the second contact surface are respectively in direct contact with the slide.

[0190] Embodiment 51: The method according to any one of the seven preceding embodiments, wherein in step c) the slide is clamped between the first contact surface and the second contact surface.

[0191] Embodiment 52: The method according to any one of the eight preceding embodiments, wherein the first gripping element comprises at least one further contact surface, wherein the further contact surface is arranged essentially perpendicular to the first contact surface.

[0192] Embodiment 53: The method according to the preceding embodiment, wherein in step b) the gripping device is moved such that when the slide is gripped via the first contact surface and the second contact surface in step c) the slide is in direct contact with the further contact surface.

[0193] Embodiment 54: The method according to any one of the two preceding embodiments, wherein in step b) the gripping device is moved such that when the slide is gripped via the first contact surface and the second contact surface in step c) the slide is arranged in a distance to the further contact surface.

[0194] Embodiment 55: The method according to the preceding embodiment, wherein after conducting step c), the following steps are conducted:

[0195] d1) a contact between the second contact surface and the slide is released, specifically by moving the second gripping element;

[0196] d2) the gripping device is moved in a direction towards the slide such that when the slide is gripped again via the first contact surface and the second contact surface the slide is in direct contact with the further contact surface; and

[0197] d3) gripping the slide via the first contact surface and the second contact surface.

[0198] Embodiment 56: The method according to any one of the twelve preceding embodiments, wherein after step c), the slide is removed from a slide tray via the gripping device.

[0199] Embodiment 57: A method for releasing at least one slide, wherein the method comprises:

[0200] providing at least one gripping device according to any one of the preceding claims referring to a gripping device, wherein at least one slide is gripped via the first contact surface of the first gripping element and the second contact surface of the second gripping element;

[0201] placing the slide into a receptacle of a slide tray;

[0202] increasing a distance between the first contact surface and the second

[0203] contact surface; and

[0204] removing the gripping device from the slide.

[0205] Embodiment 58: The method according to the preceding embodiment, wherein in step ii. the slide is placed into the receptacle of the slide tray by a combination of exclusively horizontal and vertical movements of the first contact surface and the second contact surface.

[0206] Embodiment 59: The method according to any one of the two preceding embodiments, wherein in step ii. the slide is placed into the receptacle of the slide tray by at least one tilting movement of the first contact surface and the second contact surface.

[0207] Embodiment 60: The method according to any one of the three preceding embodiments, wherein in step iv. the gripping device is removed from the slide by a combination of exclusively horizontal and vertical movements of the first contact surface and the second contact surface.

[0208] Embodiment 61: The method according to any one of the four preceding embodiments,

wherein in step iv. the gripping device is removed from the slide by at least one tilting movement of the first contact surface and the second contact surface.

[0209] Embodiment 62: A method for transferring at least one slide from at least one storage device to at least one receiving device, wherein the method comprises:

[0210] providing the least one slide in the storage device;

[0211] gripping the at least one slide via the method for gripping at least one slide according to any one of the preceding claims referring to a method for gripping at least one slide;

[0212] moving the at least one slide from the storage device to the receiving device; and

[0213] releasing the at least one slide via the method for releasing at least one slide according to any one of the preceding claims referring to a method for releasing at least one slide.

[0214] Embodiment 63: A method for imaging a plurality of slides, comprising the steps:

[0215] loading a plurality of slides into a storage device and storing the slides in the storage device;

[0216] transferring the slides from the storage device to a receiving device via the method for transferring at least one slide according to any one of the preceding claims referring to a method for transferring at least one slide from at least one storage device to at least one receiving device; and

[0217] generating an image of a sample mounted on the slide using the imaging device.

Description

BRIEF DESCRIPTION OF THE FIGURES

[0218] Further optional features and embodiments will be disclosed in more detail in the subsequent description of embodiments, preferably in conjunction with the dependent claims. Therein, the respective optional features may be realized in an isolated fashion as well as in any arbitrary feasible combination, as the skilled person will realize. The scope of the invention is not restricted by the preferred embodiments. The embodiments are schematically depicted in the Figures.

[0219] Therein, identical reference numbers in these Figures refer to identical or functionally comparable elements.

[0220] In the Figures:

[0221] FIG. 1 schematically illustrates a preferred embodiment of a first gripping element of a gripping device according to the present invention;

[0222] FIG. 2 schematically illustrates a preferred embodiment of a second gripping element of a gripping device according to the present invention;

[0223] FIG. 3 schematically illustrates a preferred embodiment of a gripping device according to the present invention;

[0224] FIGS. 4A to 4C illustrate an exemplary embodiment of a method for gripping a slide according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0225] FIG. 1 schematically illustrates a preferred embodiment of a first gripping element **110** of a gripping device according to the present invention. The first gripping element **110** is illustrated in a perspective view.

[0226] The first gripping element **110** comprises at least one first contact surface **112** for gripping a slide (not shown in FIG. 1). The first contact surface **112** may be substantially plane. The first contact surface **112** of the first gripping element **110** may have a rectangular base shape. The first contact surface **112** may have a length/and a width w , wherein the length l exceeds the width w by at least a factor of 1.5.

[0227] The first gripping element **110** may comprise at least one first contact component **114** having the first contact surface **112** and at least one first guiding component **116** being configured for guiding the first contact component **114**. The first contact component **114** and the first guiding

component **116** may exemplarily be manufactured as one single piece.

[0228] The first guiding component **116** may be an elongate element. The first contact surface **112** may be arranged essentially perpendicular to a longitudinal axis **118** of the first guiding component **116**.

[0229] The first contact component **114** may comprise at least one surface **120** opposing the first contact surface **112**. The surface **120** may be arranged at an angle smaller than 90° to the longitudinal axis **118** of the first guiding component **116**.

[0230] The first contact component **114** may comprise at least one first end **122** and at least one opposing second end **124**. The first guiding component **114** may be attached to the first contact component **114** on the second end **124**. A thickness t of the first contact component **114** may gradually decrease from the second end **124** to the first end **122**.

[0231] The first guiding component **116** may be configured for attachment to at least one actuator (not shown) configured for enabling a linear movement of the first gripping element **110**. For this purpose, the first guiding component may comprise at least one hole **126** for attachment of the first gripping element **110** to the actuator.

[0232] A connecting area **128** between the first contact component **114** and the first guiding component **116** may comprise at least one rounded corner **130**.

[0233] The first gripping element **110** may comprise at least one further contact surface **132**. The further contact surface **132** may be arranged essentially perpendicular to the first contact surface **112**. The further contact surface **132** may be configured for providing a counterforce for the slide. The further contact surface **132** may be a surface of the first guiding component **116**. The first guiding component **116** may be tapered in an area of the further contact surface **132**.

[0234] FIG. 2 schematically illustrates a preferred embodiment of a second gripping element **134** of a gripping device according to the present invention. The second gripping element **134** is illustrated in a perspective view.

[0235] The second gripping element **134** comprises at least one second contact surface **136** for gripping a slide (not shown in FIG. 2). The second contact surface **136** may be substantially plane. A detailed view on the second contact surface **136** is provided in FIG. 3.

[0236] The second gripping element **134** may comprise at least one second contact component **138** having the second contact surface **136** and at least one second guiding component **140** being configured for guiding the second contact component **138**. The second contact component **138** and the second guiding component **140** may be attached to each other, preferably materially bonded.

[0237] The second guiding component **140** may be an elongate element. The second guiding element **140** may comprise at least one first end **142** and at least one opposing second end **144**. The second contact surface **136** may be arranged at the first end **142** of the second guiding element **140**. The second guiding component **138** may taper from the first end **142** to the second end **144**.

[0238] The second contact surface **136** may be arranged essentially perpendicular to a longitudinal axis **146** of the second guiding component **140**.

[0239] The second guiding component **140** may be configured for attachment to at least one actuator (not shown) configured for enabling a linear movement of the second gripping element. For this purpose, the second guiding component **140** may comprise at least one hole **148** for attachment of the second guiding component **140** to the actuator.

[0240] FIG. 3 schematically illustrates a preferred embodiment of a gripping device **150** according to the present invention. The gripping device **150** is illustrated in a perspective view. The gripping device **150** comprises at least one first gripping element **110** and at least one second gripping element **134**. The first gripping element **110** corresponds to the first gripping element **110** as illustrated in FIG. 1. Thus, reference is made to the description of FIG. 1 above. The second gripping element **134** corresponds to the second gripping element **134** as illustrated in FIG. 2. Thus, reference is made to the description of FIG. 2 above.

[0241] FIG. 3 enables a different view on the first guiding component **116** of the first gripping

element **110**. As illustrated in FIG. 3, the first guiding component **116** may comprise at least one hole **152**, specifically at least one drill hole **154**. The hole **152** may extend along the longitudinal axis **118** of the first guiding component **116**.

[0242] Further, FIG. 3 enables a detailed view on the second contact surface **136** of the second gripping element **134**. The second contact surface **136** may essentially have a T-shape. The second contact surface **136** may extend in a plane being defined by an axis x and an axis y which are arranged perpendicular to each other. The second contact surface **136** may comprise at least one first area **156** and at least one second area **158**. The first area **156** and the second area **158** may respectively have different lengths along the axis x and the axis y. The first area **156** and the second area **158** may respectively have an essentially rectangular shape. The second area **158** may be centered aligned to the first area **156**. The second area **158** may be configured for distributing a holding force on the slide. The first area **156** may have a length $l_{sub.11}$ along the axis x and a length $l_{sub.12}$ along the axis y. The second area **158** may have a length $l_{sub.21}$ along the axis x and a length $l_{sub.22}$ along the axis y. The length $l_{sub.21}$ may be larger than the length $l_{sub.11}$, specifically by at least a factor of 1.9. The length $l_{sub.12}$ may be larger than the length $l_{sub.22}$, specifically by at least a factor of 5. The length $l_{sub.12}$ may be larger than the length $l_{sub.11}$, specifically by at least a factor of 3.5. The length $l_{sub.21}$ may be larger than the length $l_{sub.22}$, specifically by at least a factor of 2.5. The length $l_{sub.12}$ may be essentially equal to a width of the slide.

[0243] The second gripping element **134** further comprises at least two protrusions **160** which respectively extend essentially perpendicular to the second contact surface **136**. The protrusions **160** are visible in FIGS. 2 and 3. The at least two protrusions **160** are located on opposing ends **162** of the second contact surface **136**. The at least two protrusions **160** are configured for centering the slide during gripping the slide via the gripping device **150**.

[0244] A distance between the at least two protrusions **160** may be essentially equal to a width of the slide. The at least two protrusions **160** may be located on opposing ends **164** of the first area **156**. The first area **156** may be connected to the second guiding component **138** via bars **166** extending transverse to the longitudinal axis **146**. Specifically, the ends **164** of the first area **156** may respectively be connected to the second guiding component **140** via the bars **166**.

[0245] FIGS. 4A to 4C illustrate an exemplary embodiment of a method for gripping a slide **168** according to the present invention. The gripping device **150** as illustrated in FIGS. 4A to 4C corresponds to the gripping device **150** as illustrated in FIG. 3. Thus, reference to the description of FIG. 3 above is made.

[0246] As illustrated in FIG. 4A, a slide **168** may be received in a slide tray **170**. The slide **168** may be received in a receptacle **172** of the slide tray **170**. There may be gap **174** between a frame **176** of the slide tray **170** and an end face **178** of the slide **168**. The slide **169** may have a sample surface **182** and an opposing rear surface **184**.

[0247] As further illustrated in FIG. 4A, the gripping device **150** is provided and the first contact surface **112** of the first gripping element **110** and the second contact surface **136** of the second gripping element **134** are arranged in a distance to each other. The gripping device **150** is moved such that the slide **168** is arranged between the first contact surface **112** and the second contact surface **136**, specifically via the gap **174**. The gripping device **150** may be moved via a robotic arm **180**. Specially, the first contact surface **112** of the first gripping element **110** may be brought underneath the rear surface **184** of the slide **168** on the end face **178** of the slide **168**.

[0248] As illustrated in FIG. 4A, at least one first tilting movement of the gripping device **150**, specifically of the first contact surface **112** and the second contact surface **136**, such that the slide **168** is arranged between the first contact surface **112** and the second contact surface **136** may be performed. The first tiling movement may be performed by the robotic arm **180**.

[0249] As illustrated in FIG. 4B, the gripping device **150** may be moved such that when the slide **168** is gripped via the first contact surface **112** and the second contact surface **136** the slide **168** is

arranged in a distance to the further contact surface **132**.

[0250] Thereafter, as illustrated in FIG. 4C, a contact between the second contact surface **136** and the slide **168** may be released, specifically by moving the second gripping element **134**, and the gripping device **150** may be moved in a direction towards the slide **168** such that when the slide **168** is gripped again via the first contact surface **112** and the second contact surface **136** the slide **168** is in direct contact with the further contact surface **132**.

LIST OF REFERENCE NUMBERS

[0251] **110** first gripping element [0252] **112** first contact surface [0253] **114** first contact component [0254] **116** first guiding component [0255] **118** longitudinal axis [0256] **120** surface [0257] **122** first end [0258] **124** second end [0259] **126** hole [0260] **128** connecting area [0261] **130** rounded corner [0262] **132** further contact surface [0263] **134** second gripping element [0264] **136** second contact surface [0265] **138** second contact component [0266] **140** second guiding component [0267] **142** first end [0268] **144** second end [0269] **146** longitudinal axis [0270] **148** hole [0271] **150** gripping device [0272] **152** hole [0273] **154** drill hole [0274] **156** first area [0275] **158** second area [0276] **160** protrusion [0277] **162** end [0278] **164** end [0279] **166** bar [0280] **168** slide [0281] **170** slide tray [0282] **172** receptacle [0283] **174** gap [0284] **176** frame [0285] **178** end face [0286] **180** robotic arm [0287] **182** sample surface [0288] **184** rear surface

Claims

1. A gripping device configured for gripping at least one slide, wherein the gripping device comprises: at least one first gripping element, wherein the first gripping element comprises at least one first contact surface for gripping the slide; at least one second gripping element, wherein the second gripping element comprises at least one second contact surface for gripping the slide, wherein the second gripping element further comprises at least two protrusions which respectively extend essentially perpendicular to the second contact surface, wherein the at least two protrusions are located on opposing ends of the second contact surface, wherein the at least two protrusions are configured for centering the slide during gripping the slide via the gripping device; wherein the first gripping element and the second gripping element are linearly movable relative to one another, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element face each other, wherein the slide comprises at least one sample surface being configured for receiving at least one sample and at least one opposing rear surface, wherein the first contact surface of the first gripping element is configured

20. to get in contact with the rear surface, wherein the second contact surface of the second gripping element is configured to get in contact with the sample surface.

2. The gripping device of claim 1, wherein the first gripping element comprises at least one first contact component having the first contact surface and at least one first guiding component being configured for guiding the first contact component, wherein the first contact surface is arranged essentially perpendicular to a longitudinal axis of the first guiding component.

3. The gripping device of claim 2, wherein the first contact component comprises at least one surface opposing the first contact surface, wherein the surface is arranged at an angle smaller than 90° to the longitudinal axis of the first guiding component.

4. The gripping device of claim 2, wherein the first gripping element comprises at least one further contact surface, wherein the further contact surface is arranged essentially perpendicular to the first contact surface, wherein the further contact surface is configured for providing a counterforce for the slide.

5. The gripping device of claim 1, wherein the second contact surface essentially has a T-shape.

6. The gripping device of claim 1, wherein the second contact surface extends in a plane being defined by an axis x and an axis y which are arranged perpendicular to each other, wherein the second contact surface comprises at least one first area and at least one second area, wherein the

first area and the second area respectively have different lengths along the axis x and the axis y, wherein the first area and the second area respectively have an essentially rectangular shape, wherein the second area is centered aligned to the first area.

7. The gripping device of claim 6, wherein the at least two protrusions are located on opposing ends of the first area.

8. A slide transfer apparatus, wherein the slide transfer apparatus comprises: at least one storage device, wherein the storage device is loadable with a plurality of slides and configured to store the slides; at least one receiving device, wherein the receiving device is configured to receive slides transferred from the storage device; and at least one transfer device, wherein the transfer device is configured to transfer the slides from the storage device to the receiving device, wherein the transfer device comprises at least one robotic arm, wherein at least one gripping device according to claim 1 is arranged at the robotic arm.

9. A slide imaging apparatus, wherein the slide imaging apparatus comprises: at least one slide transfer apparatus according to claim 8; and at least one imaging device configured to generate an image of a sample mounted on a slide.

10. A method for gripping at least one slide, wherein the method comprises: a) providing at least one gripping device according to claim 1, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element are arranged in a distance to each other; b) moving the gripping device such that the slide is arranged between the first contact surface and the second contact surface; and c) gripping the slide via the first contact surface and the second contact surface.

11. The method of claim 10, wherein in step b) at least one tilting movement of the first contact surface and the second contact surface is performed, wherein step b) comprises the following steps: b1) performing at least one first tilting movement of the gripping device such that the slide is arranged between the first contact surface and the second contact surface; and b2) performing at least one second tilting movement of the gripping device such that the first contact surface and the second contact surface are respectively aligned essentially parallel to the slide.

12. The method of claim 10, wherein the first gripping element comprises at least one further contact surface, wherein the further contact surface is arranged essentially perpendicular to the first contact surface, wherein in step b) the gripping device is moved such that when the slide is gripped via the first contact surface and the second contact surface in step c) the slide is arranged in a distance to the further contact surface, wherein after conducting step c), the following steps are conducted: d1) a contact between the second contact surface and the slide is released; d2) the gripping device is moved in a direction towards the slide such that when the slide is gripped again via the first contact surface and the second contact surface the slide is in direct contact with the further contact surface; and d3) gripping the slide via the first contact surface and the second contact surface.

13. A method for releasing at least one slide, wherein the method comprises: i. providing at least one gripping device according to claim 1, wherein at least one slide is gripped via the first contact surface of the first gripping element and the second contact surface of the second gripping element; ii. placing the slide into a receptacle of a slide tray; iii. increasing a distance between the first contact surface and the second contact surface; and iv. removing the gripping device from the slide.

14. A method for transferring at least one slide from at least one storage device to at least one receiving device, wherein the method comprises: I. providing the least one slide in the storage device; II. gripping the at least one slide via the method for gripping at least one slide according to claim 10; III. moving the at least one slide from the storage device to the receiving device; and IV. releasing the at least one slide via the method for releasing at least one slide by: a) providing at least one gripping device according to claim 1, wherein the first contact surface of the first gripping element and the second contact surface of the second gripping element are arranged in a distance to each other; b) moving the gripping device such that the slide is arranged between the first contact

surface and the second contact surface; and c) gripping the slide via the first contact surface and the second contact surface.

15. A method for imaging a plurality of slides, comprising: A. loading a plurality of slides into a storage device and storing the slides in the storage device; B. transferring the slides from the storage device to a receiving device via the method for transferring at least one slide according to claim **14**; and C. generating an image of a sample mounted on the slide using an imaging device.
