slide through the ocular lens of a microscope allows a diagnosis upon inspection of cell characteristics or count of stained cells vs. unstained cells. Automated methods are desirable whereby digital images are collected, viewed on high resolution monitors and may be shared and archived for later use. It is advantageous that the digitization process be accomplished efficiently at a high throughput and with high resolution and high quality images.

In conventional virtual microscopy systems, imaging techniques can produce individual images that may be significantly out of focus over much of the image. Conventional imaging systems are restricted to a single focal distance for each individual snapshot taken by a camera, thus, each of these "fields of view" has areas that are out of focus when the subject specimen being scanned does not have a uniform surface. At the high magnification levels employed in virtual microscopy, specimens with a uniform surface are extremely rare.

Conventional systems use a pre-focusing technique to address the high proportion of out-of-focus images that is based on a two step process that includes: 1) determining, in a first pass, the best focus at an array of points, separated by n image frames, arranged on a two-dimensional grid laid on the top of a tissue section; and 2) in another pass, moving to each focus point and acquire an image frame. For points between these best focus points, the focus is interpolated. While this two step process may reduce or even eliminate out-of-focus images, the process results in a significant loss in the speed of acquiring the tiled images.

Accordingly, it would be desirable to provide a system that overcomes the significant problems inherent in conventional imaging systems and efficiently provides focused, high quality images at a high throughput.

SUMMARY OF THE INVENTION

According to the system described herein, a device for a microscope stage includes a moving stage block and a base block that guides the moving stage block. The base block includes a first block being substantially flat and a second block having a triangular shape, wherein the first block and the second block guide the moving stage block in a translational direction. A plurality of button elements may be disposed on the moving stage block that contact the first block and the second block, and the button elements may permit motion of

the moving stage block in only the translational direction. Positions of the plurality of button elements on the moving stage block may form a triangle. The moving stage block may be shaped to have a center of gravity at a centroid of the triangle formed by the positions of the plurality of button elements. The first block and the second block may be supported on raised bosses on a base plate. The first block and the second block may be made of glass. The button elements may be spherically shaped and made of thermoplastic. At least two of the plurality of button elements may be arranged to face each other on each side of the triangular shape of the second block, and wherein at least one button of the plurality of button elements contacts the first block on a flat face thereof. Each of the plurality of button elements may bear equal weight during stage motion. A cantilever arm assembly may be provided and a flexural element may be provided having a first end rigidly coupled to the cantilever assembly and a second end coupled to a center of mass location on the moving stage block. The cantilever arm assembly may include a cantilever arm coupled to a bearing block which runs via a recirculating bearing design on a rail. Driving of the bearing block on the rail may cause the flexural element to apply a force to the moving stage block. Bending stiffness of the flexural element may isolate the moving stage block from up and down motions of the cantilever arm assembly. The base block may form another moving stage in a direction perpendicular to the translational direction of the moving stage block. Repeatability in motion may be provided on the order of 150 nanometers. The repeatability in motion may be orthogonal to the moving stage and base block translational directions.

According further to the system described herein, a device for obtaining a focused image of a specimen includes an objective lens disposed for examination of the specimen. A slow focusing stage is coupled to the objective lens, and the slow focusing stage controls movement of the objective lens. A dither focus stage including a dither lens, and the dither focus stage moves the dither lens. A focus sensor provides focus information in accordance with light transmitted via the dither lens. At least one electrical component uses the focus information to determine a metric and a first focus position of the objective lens in

from at least a portion of the plurality of zones may be used in determining a speed of the XY moving stage. The movement of the XY moving stage may be controlled to provide forward and backward translational scanning of the specimen.

According further to the system described herein, a method for obtaining an image of a specimen includes establishing a nominal focus plane. The specimen is positioned at a starting position having associated x and y coordinates. First processing is performed in a single traversal over said specimen. The first processing includes determining, for each of a plurality of points, a focus position using a dither lens, and acquiring, for each of said plurality of points, a frame in accordance with said focus position.

According further to the system described herein, a computer readable medium comprising code stored thereon for obtaining a focused image of a specimen according to any of the above-noted steps. Further, a computer readable medium may comprise code stored thereon for performing any one of more of the processes described below.

~~According further to the system described herein, a device for a microscope stage includes a moving stage block and a base block that guides the moving stage block. The base block includes a first block being substantially flat and a second block having a triangular shape, wherein the first block and the second block guide the moving stage block in a translational direction. The first block and the second block may be supported on raised bosses on a base plate. The first block and the second block may be made of glass. A plurality of button elements may be disposed on the moving stage block that contact the first block and the second block, and the button elements may permit motion of the moving stage block in only the translational direction. The button elements may be spherically shaped and made of thermoplastic. At least two of the plurality of button elements may be arranged to face each other on each side of the triangular shape of the second block, and wherein at least one button of the plurality of button elements contacts the first block on a flat face thereof. Positions of the plurality of button elements on the moving stage block may form a triangle. Each of the plurality of button elements may bear equal weight during stage motion. The moving stage block may be shaped to have a center of gravity at a centroid of the triangle formed by the positions of the plurality of button elements. A cantilever arm assembly may be provided and a flexural element may be provided having a first end rigidly coupled to the cantilever assembly and a second end coupled to a center of mass location on the moving~~

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According further to the system described herein, a device for slide caching includes a rack, a buffer, a slide handler that moves a first slide between the rack and the buffer, and an XY stage. The XY stage moves a second slide in connection with a scan of the second slide, and at least one function of the slide handler corresponding to the first slide is performed in parallel with at least one function of the XY stage corresponding to the second slide. The slide handler may move the first slide and the second slide between the rack, the buffer and the XY stage and may move with at least three degrees of freedom. The XY stage may include a slide pickup head that moves slides from the buffer to the XY stage. An imaging device may image the first slide and the second slide, and may include a focusing system and a camera. The focusing system may include a dynamic focusing system. The function of the slide handler performed in parallel with the function of the XY stage may provide a time gain of at least 10%. The slide handler may include a slide pickup head that include a mechanical pickup device and/or a vacuum pickup device. The buffer may include a plurality of buffer positions that accept a plurality of slides. At least one buffer position of the buffer may be a position used to capture a thumbnail image of a slide. The rack may include at least one main tray and a by-pass tray, and a slide disposed in the by-pass tray is processed before any slide disposed in the main tray.

According further to the system described herein, a method for slide caching includes providing a rack and a buffer. A first slide is moved between the rack and the buffer. A second slide is moved into or out of the buffer in connection with a scan of the second slide. Moving the first slide between the rack and the buffer may be performed in parallel with the scan of the second slide. The scan of the second slide may include a focusing operation and an image capture operation. The moving of first slide in parallel with the scan of the second slide may provide a time gain of at least 10%. The scan of the second slide may include a