Title: GEMSTONE IMAGING SYSTEM AND APPARATUS AND METHOD OF USE THEREOF

Abstract: The present invention is of a gemstone imaging apparatus and system and method of use of the system in the measurement and defining of processing parameters for gemstones and diamonds while providing enhanced accuracy in measurements and in the end-product produced, than known gemstone imaging devices and methods. The gemstone imaging for use in the processing and measurement and defining of processing parameters for gemstones. The gemstone imaging system including: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing said gemstone; (c) a gemstone displacement element, attached to said gemstone securing mechanism, for rotationally displacing said gemstone in relation to said at least one lens; (d) a means for aligning and securing said at least one lens; and (e) a displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said gemstone.
FIELD OF THE INVENTION

The present invention is of a gemstone imaging apparatus and system and method of use of the system in the measurement and defining of processing parameters for gemstones. Preferably, the present invention is utilized in the processing of diamonds.

BACKGROUND OF THE INVENTION

Diamonds are employed in a wide-range of applications due to their unique physical and chemical properties. The characteristic properties include, among others, the fact that diamonds are the hardest known substance. In addition, diamonds have the highest atomic density and the highest thermal conductivity at room temperature. Diamonds exhibit low friction and wear properties, are chemically inert and are wide-band gap semiconductors. The uses of diamonds include, use in cutting tools, use in high power electronic devices, use in low friction and wear surfaces, components for electronic devices and gemstones used for jewelry purposes.

Most uses of diamonds, require processing such as shaping and polishing of the diamond surface in order to produce smooth surfaces of varying degrees depending on the desired application. In order to execute various measurements or processing of diamonds, such as angle setting,
measuring rough diamond features, measuring polished diamond features, a method commonly used uses an image of the diamond. The image of the diamond can be produced by an electronic camera system, which is connected to a computer and relevant processing software package. Thus, the diamond can then be viewed on the computer.

Owing to a wide range of diamond sizes ranging in size, in most cases, between 1mm to 80mm, a wide range of magnifications is required for the purpose of optimally viewing and thereafter, processing a gemstone.

The gemstone imaging systems of the background art include by way of example only, a system which performs angle setting, the user manually displaces a lens towards and away from a camera and the camera is also commonly displaced in relation to the gemstone, thus creating different focal lengths and magnifications.

Such a system is therefore, impractical for use in the case of enlargement or for different sized diamonds, whereby the distance of the diamond from the lens or camera must be changed repeatedly. Other processing methods utilize systems comprising one of several types of fixed magnification lenses and a fixed camera. The diamond is held in a fixed holder and therefore, the relative position of the diamond in relation to the lens or camera is fixed. In order to change the distances, one must unscrew the fixed lens or camera, replace the lens or displace the camera.
Such a system is therefore, expensive for use in the case of enlargement for different sized diamonds, different lenses are used and must be changed repeatedly.

Thus, a latent deficiency of all prior art gemstone processing systems is that all prior art gemstone systems operate at either non-optimal resolution levels or non-optimal magnification levels or both.

The background art further describes a system comprising commonly a double optical track including a camera and a lens on each optical track, which is positioned according to the size of the diamond. However, this system, which contains double sets of lenses, cameras and the diamond holders is cumbersome and very costly.

There is therefore a need for a system and method, such as is disclosed in the present invention, to provide a solution to the aforementioned problems and to be more efficient and cost-effective, while providing enhanced accuracy in measurements and in the end-product produced, than known gemstone imaging devices and methods for use in the processing and measurement and defining of processing parameters for gemstones.

SUMMARY OF THE INVENTION

The present invention is of a gemstone imaging apparatus. Moreover the present invention is of a gemstone imaging apparatus for use in the processing and determining of processing parameters of gemstones. The present invention also provides a gemstone imaging system and method for using such a system
in the processing and determining of processing parameters for gemstones. Furthermore, the present invention provides methods of use of the gemstone imaging system and apparatus. Preferably, the present invention is utilized in any of the processing stages of diamonds.

In a first embodiment the present invention provides a gemstone imaging apparatus comprising: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing a gemstone; (c) a gemstone rotational displacement element, attached to the gemstone securing mechanism, for rotateably displacing the gemstone in relation to the at least one lens; (d) a means for aligning and securing the at least one lens; and (e) a lens displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the gemstone.

In a second embodiment the present invention provides a method of imaging a gemstone comprising the steps of (a) providing a gemstone imaging apparatus comprising (i) a camera device including at least one lens for producing an image of the gemstone; (ii) a gemstone securing mechanism for securing the gemstone; (iii) a gemstone rotational displacement element, attached to the gemstone securing mechanism, for rotationally displacing the gemstone in relation to the at least one lens; (iv) a means for aligning and securing the at least one lens; and (v) a lens displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the gemstone; (b) providing a gemstone to be
secured in the gemstone imaging apparatus by the gemstone securing mechanism; (c) providing a computer for viewing the image of the gemstone; and (d) imaging the gemstone onto the computer with the provided apparatus.

In a preferred embodiment the gemstone displacement element is manually operated.

In a preferred embodiment the gemstone rotational displacement element is automatically operated.

In a preferred embodiment the displacement element is selected from the group consisting of a monorail system, a stepper system, an encoder system, a magnetic displacement system, a screw axis type system and a jumping movement system or a combination thereof.

In a preferred embodiment the lens displacement element for displacing the at least one lens is manually operated.

In a preferred embodiment the lens displacement element for displacing the at least one lens is automatically operated.

In a preferred embodiment the lens displacement element for displacing the at least one lens further comprises a clutch system.

In a preferred embodiment the gemstone is a diamond.

In a preferred embodiment the camera device is selected from the group consisting: an electronic camera electronic camera, a digital camera, a CCD, a CCTV camera and a CCIR camera.
group consisting of concave, convex, non-zoom and zoom and a combination thereof.

In a preferred embodiment the imaging is affected by operation of the camera device.

In a preferred embodiment the camera and the at least one lens are displaced until an optimal image results on the general user interface.

In a third embodiment the present invention provides a gemstone imaging system for imaging a gemstone comprising: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing the gemstone; (c) a gemstone rotational displacement element, attached to the gemstone securing mechanism, for rotationally displacing the gemstone; (d) a means for aligning and securing the at least one lens; (e) a lens displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the gemstone; (f) a gemstone; and (g) a computer for viewing the image.

In a fourth embodiment the present invention provides a diamond imaging apparatus comprising: (a) a camera device including at least one lens for producing an image of the diamond; (b) a diamond securing mechanism for securing the diamond; (c) a diamond rotational displacement element, attached to the diamond securing mechanism, for rotationally displacing the diamond in relation to the at least one lens; (d) a means for aligning and securing the at least one lens; and (e) a lens displacement element, attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the diamond.
least one lens; and (e) a lens displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the diamond.

In a fifth embodiment the present invention provides a gemstone imaging apparatus for use in an angle setting system comprising: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing the gemstone; (c) a rotational gemstone displacement element, attached to the gemstone securing mechanism, for rotationally displacing the gemstone in relation to the at least one lens; (d) a means for aligning and securing the at least one lens; (e) a lens displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the gemstone; and (f) a gemstone angle setting system comprising computer software conformed to perform angle setting functions.

In a sixth embodiment the present invention provides a method of imaging a gemstone comprising the steps of (a) providing a gemstone imaging apparatus for use in an angle setting system comprising (i) a camera device including at least one lens for producing an image of the gemstone; (ii) a gemstone securing mechanism for securing the gemstone; (iii) a gemstone rotational displacement element, attached to the gemstone securing mechanism, for rotationally displacing the gemstone in relation to the at least one lens; (v) a means for aligning and securing the at least one lens; (v) a lens displacement element attached to the means for aligning and securing the at least one lens,
for displacing the at least one lens in relation to the gemstone; and (vi) a gemstone angle setting system comprising computer software conformed to perform angle setting functions; (b) providing a gemstone; (c) imaging the gemstone with the provided apparatus to produce an image; and (d) using the in the gemstone angle setting system.

The term ‘gemstone’ as used herein shall include, but will not be limited to, any mineral or crystal that can be cut and polished for use as a gem or any precious or semi-precious stone. The stone may be rough and unprocessed or semi-processed or a finished refined, processed stone. Preferably, the gemstone is a diamond, however wherever the term ‘diamond’ is used in the specification, it is intended that any suitable gemstone may be used.

The term ‘imaging’ as used herein shall include, but will not be limited to, producing any suitable copy of the sample, such as an optically formed reproduction of an object, which includes, but is not limited to, photographing or any suitable projection on any suitable screen.

The term ‘imaging system’ as used herein shall include, but will not be limited to, any system for imaging a gemstone performing functions including, but not limited to, rough measuring, polished measuring and angle setting of a gemstone.

The term “rough gemstone” as used herein shall include, but will not be limited to, any gemstone of either cuttable or industrial quality, as it is recovered from the earth, prior to undergoing any manufacturing process or subsequently to undergoing partial processing.
The term “polished gemstone” as used herein shall include, but will not be limited to, a gemstone subsequent to undergoing polishing, process of placing facets on a rough gemstone and providing their final finish or polished gemstones, finished gemstones available for sale.

The term ‘camera device’ as used herein shall include, but will not be limited to, any photographic device with an aperture controlled by a shutter that opens to admit light or any suitable type of optical device comprising a lens system, which is capable of producing an image. The camera device may be any suitable type of camera. Preferably, the camera device is an electronic camera or a CCD camera.

The term ‘angle setting system’ as used herein shall include, but will not be limited to, any system which, functions to enable a precise setting for polishing, such that the final gemstone will comply with the following requirements of polishing parameters such as angles within a defined boundary.

The term ‘stepper system’ as used herein shall include, but will not be limited to, any system which, utilizes a brushless electrically commutated rotation magnetic field increment motor for open loop control application.

The term ‘encoder system’ as used herein shall include, but will not be limited to, any system which, utilizes a digital motion sensor including optical, magnetical, piezo or other principle elements, usually coupled with a motion elements such as electrical, pneumatic, hydraulic or other elements, to give an indication and a digital output related to direction, speed and position of the displacement, in a closed loop control system.
BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic side view of the system of the present invention; and

FIG. 2 shows a side view of one embodiment of the lens displacement system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides a gemstone imaging apparatus comprising: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing the gemstone; (c) a gemstone displacement element, attached to the gemstone securing mechanism, for displacing the gemstone in relation to the at least one lens; (d) a means for aligning and securing the camera; and (e) a displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the gemstone.

The present invention also provides a gemstone imaging system for imaging a gemstone comprising: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing the gemstone; (c) a gemstone displacement element, attached to the gemstone securing mechanism, for displacing the gemstone in relation to the at least one lens; (d) a means for aligning and securing the camera; (e) a displacement element attached to the means for aligning and securing the at least one lens.
least one lens, for displacing the at least one lens in relation to the gemstone; (f) a gemstone; and (g) a computer for viewing the image.

The present invention further provides a method of imaging a gemstone comprising the steps of (a) providing a gemstone imaging apparatus comprising (i) a camera device including at least one lens for producing an image of the gemstone; (ii) a gemstone securing mechanism for securing the gemstone; (iii) a gemstone displacement element, attached to the gemstone securing mechanism, for displacing the gemstone in relation to the at least one lens; (iv) a means for aligning and securing the camera; and (v) a displacement element attached to the means for aligning and securing the at least one lens, for displacing the at least one lens in relation to the gemstone; (b) providing a gemstone to be secured in the gemstone imaging apparatus by the gemstone securing mechanism; (c) providing a computer for viewing the image of the gemstone; and (d) imaging the gemstone on the computer with the provided apparatus.

Still further, the present invention provides a gemstone imaging apparatus for use in an imaging system comprising: (a) a camera device including at least one lens for producing an image of the gemstone; (b) a gemstone securing mechanism for securing the gemstone; (c) a gemstone displacement element, attached to the gemstone securing mechanism, for displacing the gemstone in relation to the at least one lens; (d) a means for aligning and securing the camera; (e) a displacement element attached to the means for aligning and securing the camera, for displacing the camera in
relation to the gemstone; and (f) a gemstone processing software conformed to perform gemstone processing functions.

The gemstone imaging apparatus, system and method of the present invention have wide use in the processing and more specifically in the measuring and defining of processing parameters of gemstones. Gemstone processing includes, but is not limited to cutting, polishing and final polishing and ascertaining the parameters, dimensions, geometry, angels and facets of a final polished gemstone.

The apparatus of the present invention optionally comprises a track, at least one readily displaceable lens, which lens is readily displaceable and positioning along a length of the track. Preferably, the apparatus includes a camera, which camera device is also readily displaceable along the track similarly to displacing the lens. In this way it is possible to produce an image, whereby the axis of the lateral displacement is along the path of the lens displacement on the track. The vertical displacement axis is substantially perpendicular to the lateral displacement path of the diamond, which is held by a substantially vertically displaceable securing mechanism.

Preferably, the diamond is readily rotateably displaceable about the vertical axis, thereby readily facilitating imaging the diamond from any angle.

In the gemstone imaging systems of the background art in which the lenses are fixed, when processing different sized gemstones, it is necessary for each gemstone to unscrew the lenses and change the relative distances between the camera and lenses and gemstone manually, which is time consuming and
inefficient. Alternatively, lens replacement of varying predetermined magnifications is facilitated by replacing a lens situated in a predetermined location.

Preferably, the apparatus and system of the present invention whereby a track is configured to allow free displacement of at least one lens, which is positioned on the track results in an apparatus and system which can efficiently scan any size of diamond.

Preferably, the apparatus and system of the present invention whereby a track is configured to allow free displacement of the camera, which is positioned on the track results in an apparatus and system which can efficiently scan any size of diamond.

This novel feature of the readily displaceable lens and camera readily facilitate an apparatus and system for producing enlargements and imaging of a variety of gemstone sizes, wherein the camera and/or lens can be situated at a variety of distances from the gemstone.

A further problem with the gemstone imaging methods of the background art is parallax. The system and method of the present invention is parallax free, due to the multiple lens system, wherein the lenses are not in a fixed position.

The present invention also provides an apparatus which can be incorporated into any suitable existing automatic gemstone treatment or processing system, such as but not limited to a polishing machine, such as but not limited to the Dialit GS700. The image of the diamond resulting from the
apparatus and method of the present invention as previously stated provides a means of orientation and determining of parameters used in gemstone processing, such as polishing.

The automatic imaging apparatus, system and method of the present invention therefore provides an apparatus, system and method that overcome the outlined disadvantages of the fixed lens methods or double track imaging methods available in the art.

As detailed herein, as the system of the present invention is used for readily ascertaining features, characteristics and measurements of gemstones.

For the purpose of ascertaining measurements, obtaining a scale between an image obtained by a camera and the actual size of the gemstone is essential to performing accurate measurements of the gemstone.

The principles and operation of systems according to the present invention may be better understood with reference to the figures. The figures show one embodiment of the present invention and are not limiting.

Figure 1 shows a schematic side view of an imaging apparatus according to the present invention. As can be seen in Figure 1, a gemstone, such as a diamond is secured by any suitable securing mechanism, which securing mechanism includes a means for vertical displacement of diamond. Imaging system further includes a track including a means of securing and aligning (not shown in Figure 1). At least one lens and a camera are readily displaceable along track. Track readily facilitates
lateral displacement of lenses 20 along track 18, thereby readily obtaining any
focal length or enlargement of diamond 12.

Preferably, a rotational displacement element 24 is attached to, or
integratedly formed with securing means 14 and/or diamond 12, such that
rotational displacement of securing means 14 and/or diamond 12 is readily
achieved for the purpose of viewing and/or imaging diamond 12 from any
angle.

Optionally, rotational displacement element 24 may be manually or
automatically operated. As used herein, the term ‘automatically operated’
includes, but is not limited to, automatic and semi-automatic operated rotational
displacement of diamond 12.

Optionally, manual displacement may be achieved using any suitable
manual displacement means, such as but not limited to a joystick. In an
embodiment wherein the rotational displacement element 24 is automatically
operated, the automatic displacement may be effected by way of an algorithm.

Preferably, lens 20 includes a lens displacement actuator 26 for readily
displacing lens 20 along track 18. More preferably, lens displacement actuator
26 may optionally be manually operated or automatically operated.

Optionally, manual displacement of lens 20 may be achieved using any
suitable manual displacement means 26, such as but not limited to a joystick. In
manual displacement the user controls the displacement of lens 20.

In an embodiment wherein the displacement of lens 20 is automatically
operated, the automatic displacement may be effected by way of an algorithm.
The automatic displacement effects displacement of lenses 20 and camera 22 until an optimal size of the image is achieved in the general user interface (GUI).

Preferably, camera 22 includes a camera displacement actuator 28 for readily displacing camera 22 along track 18. More preferably, camera displacement actuator 28 may optionally be manually operated or automatically operated.

Optionally, manual displacement of camera 22 may be achieved using any suitable manual displacement means 28, such as but not limited to a joystick. In manual displacement the user controls the displacement of camera 22.

In an embodiment wherein displacement of camera 22 is automatically operated, the automatic displacement may be effected by way of an algorithm.

Preferably, any suitable type of displacement system can optionally be used in the system as a lens displacement element 26 or a camera displacement element 28. Preferably, according to the method of the present invention, the displacement system can be selected from the group of: a monorail system, a stepper system, a magnetic displacement system, encoder system, a screw axis type system and a jumping movement system or a combination thereof.

Occasioning on the displacement system being a monorail system, track 18 includes an inner, monorail track and outer track (not shown in figure 1), whereby camera 22 is fixed to the outer track and lenses 20 are readily displaceable on the monorail track.
Alternatively, as shown in Figure 1, camera 22 is readily displaceable along track 18 by camera displacement actuator 28, whilst lens 20 is readily displaceable on an inner track 30 by lens displacement actuator 26.

Thus, relative displacement of lens 20 in relation to camera 22 is readily achieved.

In an embodiment, wherein the displacement employs a stepper system, the accuracy of displacement is microscopic.

Optionally any suitable number of lenses 20 and any suitable size of lens 20 may be used. Optionally, any type of suitable lens 20, such as but not limited to concave, convex, regular or zoom lenses 20 may be employed in the system and method of the present invention. It is envisioned that lens 20 may be made of any suitable material including, but not limited to, glass, Plexiglas and plastic.

Optionally, at least one lens 20 is an integral part of camera device 22 (not shown in figure 1). Optionally, camera device 22 may be any suitable type of camera 22. Preferably, the camera device is an electronic camera, digital camera, CCD, CCTV camera or CCIR.

The system of the present invention readily facilitates displacement of lenses 20 relative to each other and relative to camera device 22. In addition the system of the present invention allows displacement of gemstone 12 relative to the lenses 20 or camera 22 and vice versa. The vertical movement of the gemstone 12 is equivalent to displacement in the X axis. The horizontal
movement of the lenses 20 and/or camera 22 along the track 18 corresponds to
displacement along the Y axis.

Preferably, an illuminator 32 for illuminating diamond 12 is situated on
a substantially opposite side of diamond 12, thereby readily facilitating
illumination to reach lens 20 and camera 22 after passing through diamond 12.

Preferably, illuminator 32 readily facilitates illuminating diamond 12
with any illumination selected from the group of: visible spectrum, IR, X-ray,
and UV.

Preferably, camera 22 includes an interface 34 for readily attaching
camera 22 to a computer 36 for processing images obtained by camera 22.

Optionally, system 10 can utilize a fixed magnification lens 20 and
obtain optimal resolution and accuracy.

Alternatively, lenses 20 include a zoom capability for readily enlarging
or reducing the image of diamond 12 obtained on computer 36.

Preferably, when diamond 12 is viewed on computer 36 any area, which
exceeds the outer boundaries of diamond 12, is represented by a contrasted tone
or color.

Thus, occasioning on diamond 12 taking up more than substantially 80-
90 percent of a General User Interface (GUI) or display 38, camera 22 and/or
lens 20 are displaced away from diamond 12, thereby reducing the overall
image of diamond 12.

Alternatively, lens 20 can be displaced towards camera 22 thereby
producing a smaller image of diamond 12.
Occasioning on diamond 12 taking up less than substantially 70-80 percent of the General User Interface (GUI) or display 38, camera 22 and/or lens 20 are displaced towards diamond 12, thereby enlarging the overall image of diamond 12.

Alternatively, lens 20 can be displaced away from camera 22 thereby producing a larger image of diamond 12.

Alternatively, upon initiating system 10, camera 22 and lens 20 are displaced to a fixed position on track 18, which fixed position readily facilitates viewing diamonds and gemstones 12 having a size of up to 300mm. Thereafter, according to the overall size diamond 12 takes up on the General User Interface (GUI) or display 38, computer 36 calculates the optimal location for situating lens 20 and camera 22. Thereafter, camera 22 and/or lens 20 are displaced towards diamond 12, thereby enlarging the overall image of diamond 12 to the exact degree required or keyed in by a user.

It is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the description. The invention includes other embodiments and can be practiced or implemented in various ways. Also it is to be understood that the phraseology and terminology employed herein is for the purpose of description only and should not be regarded as limiting.

Figure 2 shows a second embodiment wherein the displacement system is a screw axis type system. As shown, Figure 2 shows a schematic side view of a second embodiment of imaging apparatus 10 according to the present
invention. As shown in Figure 2, a gemstone, such as a diamond 12 is secured by a suction securing mechanism 40, which suction securing mechanism 40 includes a means for vertical displacement 16 of diamond 12.

Preferably, an aperture 42 formed in suction securing mechanism 40 readily facilitates suction of air with a suction actuator 44, such that diamond 12 is readily inversely secured to securing mechanism 40.

Preferably, suction securing mechanism 40 is readily rotationally displaceable, such that diamond 12 is readily viewed from any angle and/or aspect.

Similarly to Figure 1, imaging system 10 further includes a track 18. At least one lens 20 and a camera 22 are readily displaceable along track 18. Track 18 readily facilitates lateral displacement of lenses 20 and/or camera 22 along track 18, thereby readily obtaining any focal length and/or enlargement of diamond 12.

Optionally, suction securing mechanism 40 may be manually or automatically rotationally displaced. As used herein, the term ‘automatically operated’ includes, but is not limited to, automatic and semi-automatic operated rotational displacement of diamond 12.

Optionally, manual rotational displacement may be achieved using any suitable manual displacement means. In an embodiment wherein the rotational displacement of suction securing mechanism 40 is automatically operated, the automatic rotational displacement may be effected by way of an algorithm.
Preferably, camera 22 is attached to, or integrally formed with a camera screw securing element 46, attached to a camera screw element 48, such that rotational displacement of camera screw element 48 results in a complimentary lateral displacement of camera screw securing element 46 and camera 22.

Preferably, a camera screw actuator 50 is attached to, or integrally formed with camera screw element 48 for readily rotateably displacing camera screw element 48.

Preferably, lens 20 is attached to, or integrally formed with a lens screw securing element 52, attached to a lens screw element 54, such that rotational displacement of lens screw element 54 results in a complimentary lateral displacement of lens screw securing element 50 and lens 20.

Preferably, a lens screw actuator 56 is attached to, or integrally formed with lens screw element 54 for readily rotateably displacing lens screw element 54.

In an embodiment wherein the displacement of lens 20 is automatically operated, the automatic displacement may be effected by way of an algorithm.

The automatic displacement effects displacement of lenses 20 and camera 22 until an optimal size of the image is achieved in the general user interface (GUI).

Optionally, manual displacement of camera 22 may be achieved using any suitable manual displacement means 50, such as but not limited to a joystick. In manual displacement the user controls the displacement of camera 22.
In an embodiment wherein displacement of camera 22 is automatically operated, the automatic displacement may be effected by way of an algorithm.

Alternatively, as shown in Figure 2, camera 22 is readily displaceable along track 18 by camera screw actuator 50, whilst lens 20 is readily displaceable on lens screw element 54 by lens screw actuator 56.

Thus, relative displacement of lens 20 in relation to camera 22 is readily achieved.

In an embodiment, wherein the displacement employs a stepper system, the accuracy of displacement is microscopic.

Likewise, any suitable number of lenses 20 and any suitable size of lens 20 may be used. Optionally, any type of suitable lens 20, such as but not limited to concave, convex, regular or zoom lenses 20 may be employed in the system and method of the present invention. It is envisioned that lens 20 may be made of any suitable material including, but not limited to, glass, Plexiglas and plastic.

Here as well, at least one lens 20 is an integral part of camera device 22 (not shown in figure 2). Optionally, camera device 22 may be any suitable type of camera 22. Preferably, the camera device is an electronic camera, digital camera, CCD, CCTV camera or CCIR.

Similarly, the system of the present invention readily facilitates displacement of lenses 20 relative to each other and relative to camera device 22. In addition the system of the present invention allows displacement of gemstone 12 relative to the lenses 20 or camera 22 and vice versa. The vertical
movement of the gemstone 12 is equivalent to displacement in the X axis. The horizontal movement of the lenses 20 and/or camera 22 along the track 18 corresponds to displacement along the Y axis.

Like in Figure 1 an illuminator 32 for illuminating diamond 12 is situated on a substantially opposite side of diamond 12, thereby readily facilitating illumination to reach lens 20 and camera 22 after passing through diamond 12.

Preferably, illuminator 32 readily facilitates illuminating diamond 12 with any illumination selected from the group of: visible spectrum, IR, X-ray, and UV.

Preferably, camera 22 includes an interface 34 for readily attaching camera 22 to a computer 36 for processing images obtained by camera 22.

Optionally, system 10 can utilize a fixed magnification lens 20 and obtain optimal resolution and accuracy.

Alternatively, lenses 20 include a zoom capability for readily enlarging or reducing the image of diamond 12 obtained on computer 36.

Preferably, when diamond 12 is viewed on computer 36 any area, which exceeds the outer boundaries of diamond 12, is represented by a contrasted tone or color.

Thus, occasioning on diamond 12 taking up more than substantially 80-90 percent of the General User Interface (GUI) or display 38, camera 22 and/or lens 20 are displaced away from diamond 12, thereby reducing the overall image of diamond 12.
Alternatively, lens 20 can be displaced towards camera 22 thereby producing a smaller image of diamond 12.

Occasioning on diamond 12 taking up less than substantially 70-80 percent of the General User Interface (GUI) or display 38, camera 22 and/or lens 20 are displaced towards diamond 12, thereby enlarging the overall image of diamond 12.

Alternatively, lens 20 can be displaced away from camera 22 thereby producing a larger image of diamond 12.

Here as well, upon initiating system 10, camera 22 and lens 20 are displaced to a fixed position on track 18, which fixed position readily facilitates viewing diamonds and gemstones 12 having a size of up to 300mm. Thereafter, according to the overall size diamond 12 takes up on the General User Interface (GUI) or display 38, computer 36 calculates the optimal location for situating lens 20 and camera 22. Thereafter, camera 22 and/or lens 20 are displaced towards diamond 12, thereby enlarging the overall image of diamond 12 to the exact degree required or keyed in by a user.

Thus, the system of the present invention is used for readily ascertaining features, characteristics and measurements of gemstones.

Preferably, for the purpose of ascertaining measurements, obtaining a scale between an image obtained by camera 22 and the actual size of gemstone 12, a calibration gauge 58, having a predetermined size, is readily replaceable with diamond 12, thereby readily providing essential calibration for performing accurate measurements of gemstone 12.
Additionally, owing to the characteristics of a geometrical cross section of gauge 58, auto-focus calibration can be readily performed by changing the focus of gauge 58 on computer 36, by way of displacing lens 20 and/or camera 22, until areas of limited contrast are reduced to a minimum, thereby facilitating auto-focus capabilities on any diamond 12 requiring imaging.

Figure 3 shows an especially preferred embodiment of an imaging apparatus 10 according to the present invention. As can be seen in Figure 3, a gemstone, such as a diamond 12 is held by any suitable securing mechanism 14.

By way of example only, in an imaging apparatus for angle setting, a ring 60 readily accommodates diamond 12. Preferably, a ring displacement mechanism 62 is provided for readily displaces ring 60, such that the substantially upper edge of ring 60 can be situated by a user at any area and/or point of diamond 12, for the purpose of obtaining optimal and/or any polishing characteristics.

Preferably, securing mechanism 14 includes a means for vertical displacement (not shown in Figure 3) of securing element 14 and diamond 12. Imaging system 10 further includes a track 18. At least one lens 20 and a camera 22 are readily displaceable along track 18. Track 18 readily facilitates lateral displacement of lenses 20 along track 18, thereby readily obtaining any focal length or enlargement of diamond 12.
Preferably, an illuminator 32 for illuminating diamond 12 is situated on a substantially opposite side of diamond 12, thereby readily facilitating illumination to reach lens 20 and camera 22 after passing through diamond 12.

A camera securer 28 is provided for readily securing camera 22, such that camera securer 28 facilitates ready displacement of camera 22 while substantially preventing camera 22 being taken out of alignment with lens 20, diamond 12 or illuminator 32.

Preferably, a displacement stabilizer 26 is situated substantially parallel to track 18 such that a lens securer 30 is readily displaceable along track 18 substantially contemporaneously as being stabilized and kept in alignment with camera 22, diamond 12 or illuminator 32.

Preferably, camera securer 28 readily secures camera 22 such that camera securer 28 facilitates ready displacement of camera 22 while substantially preventing camera 22 being taken out of alignment with lens 20, diamond 12 or illuminator 32.

Preferably, a camera displacement actuator 36 is attached to or integrally formed with camera 22 or camera securer 28 for readily displacing camera 22 along track 18. More preferably, a lens displacement actuator 38 is attached to lens 20 or lens securer 30 and which camera displacement actuator 36 may optionally be manually operated or automatically operated.

In an embodiment wherein the displacement of lens 20 is automatically operated, the automatic displacement may be effected by way of an algorithm.
The automatic displacement effects displacement of lenses 20 and camera 22 until an optimal size of the image is achieved in the general user interface (GUI).

In an embodiment wherein displacement of camera 22 is automatically operated, the automatic displacement may be effected by way of an algorithm. Preferably, any suitable type of displacement system can optionally be used in the system as a lens displacement actuator 38 or a camera displacement actuator 36. Preferably, according to the method of the present invention, the displacement system can be selected from the group of: a monorail system, a stepper system, an encoder system, a magnetic displacement system, a screw axis type system and a jumping movement system or a combination thereof.

Alternatively, as shown in Figure 3, camera 22 is readily displaceable along track 18 by camera displacement actuator 36, whilst lens 20 is readily displaceable on an inner track 64 by lens displacement actuator 38.

Thus, relative displacement of lens 20 in relation to camera 22 is readily achieved.

Preferably, camera 22 includes an interface 34 for readily attaching camera 22 to a computer 36 for processing images obtained by camera 22.

More preferably, second actuator 38 attached to lens securer 30 readily facilitates lateral displacement of lens securer 30 in relation to camera securer 28, thereby readily obtaining any focal length and/or enlargement desired.
Especially preferred, first actuator 36 and second actuator 38 are responsive to commands from computer 36.

Optionally, system 10 can utilize a fixed magnification lens 20 and obtain optimal resolution and accuracy.

Preferably, when diamond 12 is viewed on computer 36 any area, which exceeds the outer boundaries of diamond 12, is represented by a contrasted tone or color.

Thus, occasioning on diamond 12 taking up more than substantially 80-90 percent of the General User Interface (GUI) or screen (not shown in Figure 3), camera 22 and/or lens 20 are displaced away from diamond 12, thereby reducing the overall image of diamond 12.

Alternatively, lens 20 can be displaced towards camera 22 thereby producing a smaller image of diamond 12.

Occasioning on diamond 12 taking up less than substantially 70-80 percent of the General User Interface (GUI) or screen (not shown in Figure 3), camera 22 and/or lens 20 are displaced towards diamond 12, thereby enlarging the overall image of diamond 12.

Alternatively, lens 20 can be displaced away from camera 22 thereby producing a larger image of diamond 12.

Alternatively, upon initiating system 10, camera 22 and lens 20 are displaced to a fixed position on track, which readily facilitates viewing diamonds and gemstones 12 having a size of 100mm. Thereafter, according to the overall size diamond 12 takes up on the General User Interface (GUI) or
screen (not shown in Figure 3), computer 36 calculates the optimal location for situating lens 20 and camera 22. Thereafter, camera 22 and/or lens 20 are displaced towards diamond 12, thereby enlarging the overall image of diamond 12 to the exact degree required or keyed in by a user.

The present invention may be better understood with reference to the examples and the accompanying description.

Example 1

The photographic system of the present invention has been employed in a diamond angle setting system. The angle setting system can serve an automatic gemstone polishing machine and functions to enable a precise setting of the polishing so that the final stone will comply with the following requirements of polishing angles within a defined boundary, maximizing of the yield and leaving naturals within a defined boundary.

A diamond is placed and secured in the securing mechanism of the apparatus of the present invention. Two lenses are placed on the track. The lenses are automatically displaced on the track and the diamond is automatically displaced until an optimal image of the diamond is obtained on the GUI of the computer. The image of the diamond produced by the system of the present invention is viewed on the screen of the computer, which includes software for the angle setting system. Consequently, the angle setting system uses the produced image to analyze the sample diamond and to determine the diamond's angle size and to measure diameter of the diamond. These parameters are then used to polish the sample diamond.
While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made.
What is claimed is:

1. A gemstone imaging apparatus comprising:
   (a) a camera device including at least one lens for producing an image of the gemstone;
   (b) a gemstone securing mechanism for securing said gemstone;
   (c) a gemstone displacement element, attached to said gemstone securing mechanism, for rotationally displacing said gemstone in relation to said at least one lens;
   (d) a means for aligning and securing said at least one lens; and
   (e) a displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said gemstone.

2. The gemstone imaging apparatus of claim 1, wherein said gemstone rotational displacement element is manually operated.

3. The gemstone imaging apparatus of claim 1, wherein said gemstone rotational displacement element is automatically operated.

4. The gemstone imaging apparatus of claim 1, further comprising a lens displacement element selected from the group consisting of: a mono rail system, a stepper system, an encoder system, a magnetic displacement system,
a screw axis type system and a jumping movement system or a combination thereof.

5. The gemstone imaging apparatus of claim 1, wherein said lens displacement element for displacing said at least one lens is manually operated.

6. The gemstone imaging apparatus of claim 1, wherein said lens displacement element for displacing said at least one lens is automatically operated.

7. The gemstone imaging apparatus of claim 1, wherein said lens displacement element for displacing said at least one lens further comprises a clutch system.

8. The gemstone imaging apparatus of claim 1, wherein said gemstone is a diamond.

9. The gemstone imaging apparatus of claim 1, wherein said camera device is selected from the group consisting: an electronic camera electronic camera, a digital camera, a CCD, a CCTV camera and a CCIR camera.
10. The gemstone imaging apparatus of claim 1, wherein said at least one lens is selected from the group consisting of concave, convex, non-zoom and zoom and a combination thereof.

11. A method of imaging a gemstone comprising the steps of
   (a) providing a gemstone imaging apparatus comprising
       (i) a camera device including at least one lens for producing an image of the gemstone;
       (ii) a gemstone securing mechanism for securing said gemstone;
       (iii) a gemstone rotational displacement element, attached to said gemstone securing mechanism, for rotationally displacing said gemstone in relation to said at least one lens;
       (iv) a means for aligning and securing said at least one lens; and
       (v) a lens displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said gemstone;
   (b) providing a gemstone to be secured in said gemstone imaging apparatus by said gemstone securing mechanism;
   (c) providing a computer for viewing said image of said gemstone; and
   (d) imaging said gemstone onto said computer with said provided apparatus.
12. The method of claim 11, wherein said gemstone rotational displacement element is manually operated.

13. The method of claim 11, wherein said gemstone rotational displacement element is automatically operated.

14. The method of claim 11, wherein said lens displacement element is selected from the group consisting of a mono rail system, a stepper system, an encoder system, a magnetic displacement system, a screw axis type system and a jumping movement system or a combination thereof.

15. The method of claim 11, wherein said lens displacement element for displacing said at least one lens is manually operated.

16. The method of claim 11, wherein said lens displacement element for displacing said at least one lens is automatically operated.

17. The method of claim 11, wherein said lens displacement element for displacing said at least one lens further comprises a clutch system.

18. The method of claim 11, wherein said gemstone is a diamond.
19. The method of claim 11, wherein said camera device is selected from the group consisting: an electronic camera electronic camera, a digital camera, a CCD, a CCTV camera and a CCIR camera.

20. The method of claim 11, wherein said imaging is affected by operation of said camera device.

21. The method of claim 11, wherein said camera and said at least one lens are displaced until an optimal image results on the general user interface.

22. The method of claim 11, wherein said at least one lens is selected from the group consisting of concave, convex, non-zoom and zoom and a combination thereof.

23. A gemstone imaging system for imaging a gemstone comprising:
   (a) a camera device including at least one lens for producing an image of the gemstone;
   (b) a gemstone securing mechanism for securing said gemstone;
   (c) a gemstone displacement element, attached to said gemstone securing mechanism, for displacing said gemstone in relation to said at least one lens;
   (d) a means for aligning and securing said at least one lens;
(c) a displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said gemstone;

(f) a gemstone; and

(g) a computer for viewing the image.

24. A diamond imaging system comprising:

(a) a camera device including at least one lens for producing an image of the diamond;

(b) a diamond securing mechanism for securing said diamond;

(c) a diamond displacement element, attached to said diamond securing mechanism, for displacing said diamond in relation to said at least one lens;

(d) a means for aligning and securing said at least one lens; and

(e) a displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said diamond.

25. A gemstone imaging apparatus for use in an angle setting system comprising:

(a) a camera device including at least one lens for producing an image of the gemstone;

(b) a gemstone securing mechanism for securing said gemstone;
(c) a gemstone rotational displacement element, attached to said gemstone securing mechanism, for rotationally displacing said gemstone;

(d) a means for aligning and securing said at least one lens;

(e) a displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said gemstone; and

(f) a gemstone angle setting system, comprising computer software conformed to perform angle setting functions.

26. A method of imaging a gemstone comprising the steps of

(a) providing a gemstone imaging apparatus for use in an angle setting system comprising

   (i) a camera device including at least one lens for producing an image of the gemstone;

   (ii) a gemstone securing mechanism for securing said gemstone;

   (iii) a gemstone displacement element, attached to said gemstone securing mechanism, for displacing said gemstone in relation to said at least one lens;

   (iv) a means for aligning and securing said at least one lens;
(v) a displacement element attached to said means for aligning and securing said at least one lens, for displacing said at least one lens in relation to said gemstone; and

(v) a gemstone angle setting system comprising computer software conformed to perform angle setting functions;

(b) providing a gemstone;

(c) imaging said gemstone with said provided apparatus to produce an image; and

(d) using said image in said gemstone angle setting system.

27. The apparatus according to any one of claim 1-10, 24, 25 substantially as herein described and with reference to the figures and examples.

28. The system according to claim 23 substantially as herein described and with reference to the figures and examples.

29. The method according to any one of claims 11-22, 26, substantially as herein described and with reference to the figures and examples.

30. An angle setting system for aiding any diamond processing process comprising:
(a) a body having a length and a width;
(b) a lens readily displaceable along the length of said body;
(c) a gemstone secured proximally to a first extremity of said length of said body, such that displacing said lens produces an image having a plurality of magnifications and sharpness levels; and
(d) a display for displaying said image to the user.

31. A gemstone imaging apparatus of claims 1-10 wherein the gemstone imaging apparatus is incorporated into any existing automatic gemstone treatment or processing system.

32. The gemstone imaging apparatus of claim 31, wherein the automated gemstone processing system is the Dialit GS7000.

33. A gemstone imaging apparatus comprising:
(a) a camera device including at least one lens for producing an image of the gemstone;
(b) a gemstone securing mechanism for securing said gemstone;
(c) a gemstone displacement element, attached to said gemstone securing mechanism, for rotationally displacing said gemstone in relation to said at least one lens;
(d) a means for aligning and securing said at least one lens; and
(e) a camera displacement element attached to said camera, for displacing said camera.

34. An angle setting system for aiding any diamond processing process comprising:

(a) a body having a length and a width;

(b) a lens readily displaceable along the length of said body;

(c) a camera, wherein said camera is readily displaceable along the length of said body;

(d) a gemstone secured proximally to a first extremity of said length of said body, such that displacing said camera and said lens produces an image having a plurality of magnifications and sharpness levels; and

(e) a display for displaying said image to the user.

35. An angle setting system for aiding any diamond processing process comprising:

(a) a body having a length and a width;

(b) a camera including a lens, wherein said camera is readily displaceable along the length of said body;

(c) a gemstone secured proximally to a first extremity of said length of said body, such that displacing said camera produces an image having a plurality of magnifications and sharpness levels; and
(d) a display for displaying said image to the user.