material by rotating the periscope about the first axis and rotating the periscope about the second axis to restore the optical axis path to its original length.

5. U.S. Pat. No. 5,753,344—"In-Line Printing Production of Three Dimensional Image Products Incorporating Lenticular Transparent Material", by Jacobsen

The patent to Jacobsen provides a method of producing in a single in-line process a printed image suitable for creating an illusion of depth in the perception of a viewer of the image, comprising the steps of: (1) providing an opaque web to an in-line printing process, (2) providing a transparent web to the in-line printing process, the transparent web having a lenticular surface on one side and a flat surface on an opposing side, (3) transporting either the opaque web or the transparent web to a first printer unit of the in-line printing process at a pre-selected speed and printing a lineformed image on the opaque web or the flat surface of the transparent web, the lineformed image being compatible for viewing when viewed through the lenticular surface of the transparent web, and (4) setting the image on either the opaque web or flat surface of the transparent web in a heat setting unit of the in-line printing process.

6. U.S. Pat. No. 4,929,402—"Method For Production of Three Dimensional Objects by Sterolithography", by 1-Iull

In the patent to Hull, described is a system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed at a selected surface of a fluid medium capable of altering its physical state in response to appropriate synergistic stimulation by impinging radiation, particle bombardment or chemical reaction, successive adjacent laminae, representing corresponding successive adjacent cross-sections of the object, being automatically formed and integrated together to provide a step-wise laminar buildup of the desired object, whereby a three-dimensional object is formed and drawn from a substantially planar surface of the fluid medium during the forming process.

Unlike in the patents referenced above, the present invention includes the usage of a three dimensional printing device that is suitable for telemanufacturing purposes, wherein digital files containing "x", "y" and "z" coordinate information may be sent to the printing device remotely.

None of the above inventions and patents, taken either singly or in combination, is seen to describe the instant invention as claimed.

SUMMARY OF THE INVENTION

The current invention discloses a method and apparatus for displaying a three dimensional image and for using the same display as an input scanner device for scanning an object to be displayed later or at a remote device. The display presents both a three dimensional image by providing color elements along a three dimensional grid, but also a three dimensional display that can present a touchable, concrete image three dimensional image that can be changed in real time.

In a first embodiment, a rectangular grid of pins is connected to a control circuit to move the pins independently of each other to form a predetermined contour based on an input signal. The pins can move in at least one direction to approximate the shape of an three dimensional object described in a digital file ("digital image"). The pins also contain an array of lighting elements such as LEDs or fiber optic lights to present an accurate color image of the object being displayed. The combination of the three dimensional contour and color display in the three dimensional grid for a three dimensional replication of the original object in real time. The display can be viewed to appreciate the three dimensional character of the display, and can be touched and felt to provide tactile feedback to the viewer.

By including appropriate sensors in the pins at the ends or along the bodies, the three dimensional display can also act as a tactile scanner. The pins may include force sensors, brightness or color sensors, general light sensors, and position indicators to scan the properties of an object in contact with or near the scanner. The information sensed by the scanner can be written to a digital file or transferred by analog or digital means to a storage location or to a remote three dimensional display for presentation to another viewer to provide three dimensional communication.

The display can be covered in a latex or similar material to enhance the sense of feel to the display. The cover material also provides a moisture and dust barrier to the device and can be used in conjunction with the light sources to enhance the display. In a preferred embodiment, the sense of feel is further enhanced by providing the pins with an adjustable hardness that can be controlled by the signal to further enhance the tactile response by the viewer. The temperature of the individual rods can also be controlled in response to a control signal by electrical heating or cooling of the elements to further enhance the tactile response.

In a second embodiment, a three dimensional display is formed as a stationary display capable of providing a three dimensional display. A cube, sphere or other regular or irregular geometric shape is provide with a grip of fiber optic cables grouped together in parallel to fill the entire space of the display. The cables are transparent and have along their lengths display points to create a three dimensional grid of "pixels" which are capable of presenting a particular color and brightness at each pixel. The geometric display can thus present a three dimensional object by coloring each pixel within the three dimensional grid to show both the contour and color image of the object to be displayed without any moving parts.

In a third embodiment, the fiber optic cable pixels are replaced by a three dimensional grid of LCD or other light emitting devices fixed in a glass or other transparent medium. By applying an electric signal to the "pixels" formed by each LCD, the display forms a three-dimensional monitor capable of showing both the contour and color properties of the object.

Accordingly, it is a principal object of the invention to provide a three dimensional display that can simulate the contour and texture of a image from a digital representation of that object.

It is another object of the invention to provide a three dimensional display that had a number of moveable display elements that can be arranged to present a contour, shape, and image of an object in three dimensions.

It is a further object of the invention to provide a method of displaying a three dimensional object defined by a computer readable signal in three dimensions to display not only a visual image in a three dimensional grid, but to also selectively imbue the display with the properties of hardness, temperature, and feel of the object.

Still another object of the invention is to provide a three dimensional scanner for determining the size, shape, feel, temperature, color, brightness, and hardness of an object and storing the characteristics in machine readable form for later recall or transmission to a remote user.

It is an object of the invention to provide a stationary three dimensional display having a fixed grid of pixels in three dimensions for displaying an image.