or the left rod **4-111** and the right rod **4-112** may be made of different materials to achieve different growth characteristics due to the application of electric current. By varying the current applied to each of the left rod **4-111** and the right rod **4-112**, or by using different materials for left rod **4-111** and the right rod **4-112**, the actuator **4-11** can flex in each direction in a 1-dimensional plane. According to an aspect of the present embodiment, an actuator may tilt only in one direction, in which case a set of differently tilting actuators would be arranged in an adjacent fashion.

[0052] According to an aspect of the present embodiment, a third rod is added to the actuator **4-11**, so that two-dimensional movement of the tip of the actuator **4-11** may be accomplished. Such additional rods may further be added to achieve finer control over the direction of the tilt of the actuator in two-dimensions, or even in three-dimensions, because the degree to which the tip of the actuator bends and its direction is controlled by the current supplied to the rods. For example, three rods may be sufficient for each actuator **4-10** to control movement in at least four directions. A cross section view of actuator **4-11** is shows as **4-40** of FIG. **4**C.

[0053] According to an aspect of the present embodiment, the rods of the actuators **4-10** are formed of polymers. An image display could be a polymer LED display. Further, piezo-electric ceramics may be used for the actuators **4-10**. Piezo-electric ceramics are used in STM (Scanning Tunnel Microscope) devices for nanometer precise movement. It will be understood that various combinations of materials could be used for the rods of the actuators **4-10** and that different materials could be used for different actuators **4-10** of the image display **4-1**.

[0054] The activation of the actuators **4-10** may be controlled in a manner similar to the passive matrix addressing described with reference to the third embodiment. Column-electrodes and row-electrodes may be deployed to control an individual actuator **4-11**.

[0055] According to an aspect of the present embodiment, the actuators **4-10** may be placed between pixels of the image display **4-1**. Also, an actuator **4-11** may be arranged between every pixel **4-50**, as shown in FIG. **4**A. By movement of the actuators **4-10**, a motion of an object can be achieved in the direction of the tilt of the actuators **4-10**.

[0056] Further, it will be appreciated that longer motions of an object along the surface of the image display **4-1** could be achieved by serial activation of actuators **4-10**. More than one actuator **4-11** may be activated at any one time and several actuators **4-10** in any one area of the image display **4-1** could be used to move an object. For example, a time-delayed activation of adjacent actuators toward a similar tilt would cause the object to experience continuous pushing from behind, causing a longer movement. Also, the amount of current applied to actuators **4-10** could be controlled, based on the type of application (for example type of object to be moved: in chess for example, there are smaller and larger pieces), and the desired speed of the motion. Fine control over the timing of the activation sequence of the actuators **4-10** could then effect acceleration, deceleration and speed control of the object. Similarly, an object trajectory resembling a curve or other shape could be achieved by a precise series of actuators **4-10** activations.

[0057] Also, a tactile sensation or tactile feedback may be provided to the user's finger at selected portions of the image display **4-1**. According to an aspect of the present invention, using fine movement control of an image display according to the present invention, the user may feel little bumps of an image displayed, when touched. This can also be used for Braille output. In such an embodiment, blind people may use the image display for reading.

[0058] According to an aspect of the invention, the actuators **4-10** may also provide touch-sensitivity for the image display **4-1**. For instance, a user's finger touching at the surface of the image display **4-1** would cause a movement of the actuators **4-10** which would cause the flow of current to be affected, for example, by causing current to flow. Such an arrangement of piezo-electronic materials will be well known to those skilled in the art. Accordingly, the actuators could provide an image display **4-10** with both tactile sensation and touch sensing. Similarly with the other embodiments of the present invention, touch sensitivity could be provided. For example, a movement of a rod **2-10**, or a movement of a ball bearing **1-10**, caused by the user's finger (thumb, hand, et cetera) at the surface could sensed.

[0059] It will be appreciated that an image display according to the present invention could be made using a combination of the embodiments 1-4 described herein.

[0060] Embodiments of the present invention provided in the foregoing written description are intended merely as illustrative examples. It will be understood however, that the scope of the invention is provided in the claims.

1. An image display, the image display comprising:
- a pixel-actuator matrix (**4-19**) including a set of actuators (**4-10**); and
- an actuator (**4-11**) of the set of actuators comprised of a plurality of conductive rods (**4-111**, **4-112**) attached together, each rod of the actuator disposed to one of increase and decrease in size when current is applied to that rod to cause the actuator to bend toward a specified direction according to a received movement signal.

2. The image display of claim **1**, wherein at least a portion of the pixel-actuator matrix is configured to move an object (**3-2**) at a surface thereof in the specified direction.

3. The image display of claim **1**, wherein each rod of the plurality of rods is comprised of piezo-electric ceramics.

4. The image display of claim **16**, wherein each rod of the plurality of the rods is comprised of conductive polymers.

5. The image display of claim **1**, wherein the actuator is arranged between pixels (**4-50**) of the pixel-actuator matrix.

6. The image display of claim **1**, wherein, according to the movement signal, a movement is provided at least one of to provide a haptic sensation and to provide a motion of an object at the surface of said image display.

7. The image display of claim **1**, wherein the actuator consists of three rods arranged such that responsive to application of a current to one or more of the three rods, the actuator bends toward one of at least four specifiable directions.

8. The image display of claim **1**, wherein the actuator provides touch sensitivity for the image display.

9. An image display configured to move an object near a surface of the image display, said image display comprising:
- a ball bearing assembly (**1-1**) including a ball bearing (**1-10**); and
- said ball bearing (**1-10**) arranged such that a rotation direction of said ball bearing is controlled by magnets (**1-21**, **1-22**) to cause an object (**3-2**) at a surface of the image display to be moved in a specified direction by the movement of the ball bearing along a rotation direction of the ball bearing.