LIGHT-INDUCED SHAPE-MEMORY POLYMER DISPLAY SCREEN

BACKGROUND

[0001] A computing device with a display screen may be configured to detect touches directed at the display screen. Thus, such a display screen may not only display images to a user but may also visually present a user interface (e.g., a virtual keyboard) with which a user may interact via input touches. Typically, such display screens provide a smooth look and feel to a user.

SUMMARY

[0002] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages noted in any part of this disclosure.

[0003] A light-induced shape-memory polymer display screen is provided herein. One example display device includes a display screen having a topography-changing layer including a light-induced shape-memory polymer. The display device further includes an imaging engine configured to project visible light onto the display screen, where the visible light may be modulated at a pixel level to form a display image thereon. The display device further includes a topography-changing engine configured to project agitation light of an ultraviolet band towards the display screen, where the agitation light is modulated at a pixel level to selectively change a topography of the topography-changing layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. **1** shows a block diagram of an embodiment of a surface computing system in accordance with the present disclosure.

[0005] FIG. **2** schematically shows agitation light projected onto a light-induced shape-memory polymer in accordance with an embodiment of the present disclosure.

[0006] FIG. **3** schematically shows an example embodiment of light-induced shape-memory polymers.

[0007] FIG. **4** schematically shows another example embodiment of light-induced shape-memory polymers.

[0008] FIG. **5** schematically shows a user interacting with an example display screen having a topography-changing layer.

[0009] FIG. **6** schematically shows an example embodiment of a surface computing system.

DETAILED DESCRIPTION

[0010] The present disclosure relates to display devices configured to include a topography-changing layer in the display screen, where the topography-changing layer includes shape-memory polymers. Such shape-memory polymers are a type of "smart material" capable of being manipulated via external stimuli. More generally, properties (e.g., length, width, shape, etc.) of smart materials may be changed in a controlled manner by external stimuli such as light, electricity, sound, water, temperature, etc. Shape-memory polymers are then a particular subset of smart materials including polymers capable of adjusting their shape by transforming from an original state to a deformed state when induced by an external stimulus. Such shape-memory polymers may be further capable of returning to their original "memorized" state from the deformed state when induced by another external stimulus.

[0011] Shape-memory polymers activated by light illumination are called light-induced shape-memory polymers (i.e., light-activated shape-memory polymers). In some cases, these materials may be deformed and fixed into predetermined shapes via ultraviolet light illumination. By including such materials within a display screen, a tangible dimension in the form of a topography-changing layer is included within an otherwise flat display surface. Such a configuration may help provide a natural/tangible user experience, as described in more detail as follows.

[0012] FIG. **1** shows an embodiment of a surface computing system **100**. Surface computing system **100** may include a display device including a projection display system for projecting images from an image source onto a display screen **102**. Such a projection display system may include an imaging system, such as imaging engine **104**, configured to project visible light onto display screen **102**. This visible light may be modulated at a pixel level to form a display image on display screen **102**. In other words, each pixel location of the display screen is individually addressable so that a selected color may be displayed at that pixel. In this way, different colors may be projected to the various pixels so that the pixels collectively form a desired image. Examples of imaging engine **104** include an LCD (liquid crystal display), an LCOS (liquid crystal on silicon) display, a DLP (digital light processing) display, and the like.

[0013] Surface computing system **100** may further include a touch module **106** for detecting and recognizing touches directed at display screen **102**. Touch module **106** may detect and recognize input touches in any suitable manner. As an example, touch module **106** may include a reference engine **108** configured to project reference light towards display screen **102**. Such reference light may be of any suitable wavelength, such as light of an infrared band. A touch-detection engine, such as touch-detection engine **110**, may then be configured to recognize touch inputs directed at the display by detecting changes in the reflection of the reference light away from a backside of display screen **102** (e.g., as a result of a finger touching a front side of the display screen **102**). For example, touch-detection engine **110** may detect a relative amount or pattern of the reference light reflected away from a backside of the display screen. Upon doing so, touch-detection engine **110** may then be further configured correlate the relative amount or pattern of the reference light reflected from the display screen **102** to touch inputs directed to various locations of the display screen. In other words, when an input touch is present on a display screen, reference light directed toward an underside of the display screen may be reflected back away from the display screen at the area of the display screen contacted by the input touch. Accordingly, detecting a relative amount of this reflected light, or a pattern in this reflected light, allows the surface computing system to recognize the presence and location of the input touch on the display screen.

[0014] It can be appreciated that touch module **106** may be configured to detect input touches by another suitable method such as capacitive or resistive detection. Another embodiment of an example surface computing system including a projec-