

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
2 December 2010 (02.12.2010)

PCT

(10) International Publication Number  
**WO 2010/138568 A2**

(51) International Patent Classification:  
**G06F 3/041** (2006.01) **G06F 3/042** (2006.01)

(21) International Application Number:  
PCT/US2010/036175

(22) International Filing Date:  
26 May 2010 (26.05.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
61/181,716 28 May 2009 (28.05.2009) US

(71) Applicant (for all designated States except US): **KENT DISPLAYS INCORPORATED** [—/US]; 343 Portage Blvd., Kent, OH 44240 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **GREEN, Albert** [US/US]; 485 Overlook Drive, Kent, OH 44240 (US). **HUANG, Xiao-yang** [US/US]; 4622 Dresher Trail, Stow, OH 44224 (US). **SCHNEIDER, Tod, L.** [US/US]; 723 Allerton Street, Kent, OH 44240 (US).

(74) Agents: **BODI, Robert, F.** et al.; Pearne & Gordon LLP, 1801 East 9th Street, Suite 1200, Cleveland, OH 44114-3108 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: WRITING TABLET INFORMATION RECORDING DEVICE

(57) Abstract: A writing/drawing tablet utilizing a data capture device such as a pressure sensitive display that can capture data from the resulting image drawn on the device. In general, Bistable Liquid Crystal Displays (BLCD), and in particular, Cholesteric Liquid Crystal Displays (ChLCDs), can be utilized in such a device to create low cost pressure sensitive displays that are efficient power consumers and that can be utilized in a number of unique devices.



WO 2010/138568 A2

## **Writing Tablet Information Recording Device**

### **CROSS-REFERENCES TO RELATED APPLICATIONS**

[0001] This application claims the benefit of U.S. provisional application serial number 61/181,716 filed on May 28, 2009, and incorporated herein by reference.

### **BACKGROUND OF THE INVENTION**

[0002] This application relates generally to a writing/drawing tablet utilizing a pressure sensitive display that can capture data from the resulting image. In general, Bistable Liquid Crystal Displays (BLCD), and in particular, Cholesteric Liquid Crystal Displays (ChLCDs), have proven to have great potential to create low cost pressure sensitive displays that are efficient power consumers and that can be utilized in a number of unique devices.

[0003] There have been various technological approaches to produce a writing pad as a replacement of paper and pencil or chalk on slate. The best known examples are toys. The ETCH-A-SKETCH™, introduced in the 1960s, is one such device. In this device, a movable stylus removes a powder material from inside a screen to make a dark line. The image is erased by turning the device upside down and shaking it to smooth out the surface. Another famous example is the MAGNA DOODLE™, which is a magnetophoretic device in which a stylus with a magnet on the tip is used as the pen to draw a line. The device is erased with a thin long magnet behind the screen. Over 40 million of these devices have been reportedly sold.

[0004] Recently, the pressure sensitive cholesteric liquid crystal writing tablet, Boogie Board™ of Improv Electronics has appeared on the market in which a pointed stylus or the finger can be used to write or trace an image on the

surface of the tablet. This tablet offers a considerable improvement over previous tablet technologies in that the image can be simply and instantly erased with the push of a button that applies a low voltage pulse electrodes in the tablet. In a cholesteric liquid crystal tablet, the liquid crystal is sandwiched between two substrates that are spaced to a particular gap. The upper substrate is flexible and the bottom substrate is painted with a light absorbing (black or colored) background. The cell gap is usually set by plastic or glass spacers that are either cylindrical or spherical in shape. When one presses on the top substrate with a point stylus or finger, the liquid crystal is locally displaced. Flow induced in the liquid crystal changes its optical texture from a transparent to a brilliant reflective color at the location of the stylus. The reflective color contrasts well to the dark background of the lower substrate. An image traced by the stylus or finger will remain on the tablet indefinitely until erased. Erasure is accomplished by applying a voltage pulse to electrodes transparent conducting electrodes on the inner surface of the substrates that drive the cholesteric liquid crystal for its color reflective state back to its transparent state.

[0005] The above described principle is disclosed in more detail in US Patent 6,104,448, incorporated herein by reference. Polymer dispersions can be used to control the pressure sensitivity and resolution of the image as described in US Patent Application Publication 2009/0033811, incorporated herein by reference. Other modes of operation include multiple color images and select erase are described th patent application publication given above as well as US Patent Application Publication 2009/0096942, incorporated herein by reference.

[0006] There are other approaches to hand tracing an image on a screen that have been digital in nature but unlike the above examples the traced image does not appear directly on the surface under the stylus or finger but on a remote screen such as a desktop or laptop screen. One such example is the Bamboo Pen Tablet of Wacom Co. Ltd. A specially designed pen is used on a pad surface to sketch, doodle or mark up documents that appear on a computer

screen; the image is not seen on the pad surface itself. This writing method is unnatural to the user in that the user must look away from the writing surface to see what is being written, and has difficulty resuming work after a break because it can be problematic to determine where the image of the screen corresponds to a location on the tablet.

[0007] It would therefore be desirable to have a writing tablet device, like the cholesteric liquid crystal writing tablet described above, where an image being drawn is directly observed on the writing pad but simultaneously (or subsequently) captured electronically and digitized so as to be observed on a computer screen as well as stored for later recall and use. It ~~is of~~ would be further useful that the device be operable without a special stylus but with any untethered pointed object such as a finger or fingernail. Other features such as low-cost and low-power requirements would be of further advantage.

#### **SUMMARY OF THE INVENTION**

[0008] Provided are a plurality of embodiments the invention, including, but not limited to, a writing/drawing tablet with an integrated data capture feature for capturing the image written on the writing/drawing tablet into a memory.

[0009] Also provided is a writing/drawing tablet device with data capture comprising: a drawing surface integrated in the tablet and adapted to display back to the user a result of an image drawn or written upon the drawing surface by the user, and a data capture device for capturing the image drawn or written upon the drawing surface for storing in a memory device. The display back to the user of the image drawn or written upon the drawing surface does not require the consumption of electrical power from any power source.

[0010] Further provided is the above tablet device where the device has any one or more of the following features:

- [0011] The drawing surface comprises an LCD for displaying back the image drawn or written on the drawing surface;
- [0012] The drawing surface comprises a cholesteric LCD for displaying back the image drawn or written on the drawing surface;
- [0013] The drawing surface is a pressure sensitive drawing surface and wherein the image is drawn or written upon the drawing surface by applying pressure to the drawing surface, and in some embodiments: (1) wherein the pressure is applied to the drawing surface using a stylus, (2) wherein the data capture device is adapted to convert pressure points to electrical signals for capturing the image drawn or written upon the drawing surface into the memory device, and/or (3) wherein the data capture device comprises a touch screen device utilized for capturing the image drawn or written upon the drawing surface into the memory device;
- [0014] Wherein the data capture device comprises an optical scanning device that is utilized for capturing the image drawn or written upon the drawing surface into the memory device;
- [0015] Wherein the data capture device comprises a touch screen device utilized for capturing the image drawn or written upon the drawing surface into the memory device;
- [0016] Wherein the memory device is a flash memory or RAM comprised in the tablet device;
- [0017] Further comprising a data interface, wherein the memory device is included in an external device communicating

with the tablet device utilizing the data interface for capturing the image;

- [0018] Further comprising a data interface, wherein the memory device is included in an external device communicating with the tablet device utilizing the data interface for capturing the image, wherein the memory device is used to reproduce the image on a remote display included with the external device;
- [0019] Further comprising an additional display for displaying a replica of the image the captured in the memory device, and in some embodiments wherein the table device is adapted such that additional images previously stored in the memory device can be displayed on the additional display when selected by the user for such display, and in some embodiments further comprising a rechargeable battery for providing power to the tablet device for powering the additional display and in some embodiments further comprising a solar cell for charging the rechargeable battery, and/or further comprising an erase actuator, such that activation of the erase actuator by the user erases the image drawn or written upon the drawing surface by application of a voltage to the drawing surface;
- [0020] Further comprising an erase actuator, such that activation of the erase actuator by the user erases the image drawn or written upon the drawing surface by application of a voltage to the drawing surface;
- [0021] Wherein the pressure sensitive data capture surface includes a resistive or inductive touchscreen;

[0022] Further comprising a processor for processing the image captured by the data capture device prior to storing the image in the memory device; and/or

[0023] Wherein the memory device is included in the tablet, with some additional embodiments further comprising a memory interface wherein the memory device communicates with the tablet via the memory interface and the memory device is removable from the tablet by a user.

[0024] Also provided is writing/drawing tablet device with data capture comprising: a power supply for powering the device; a memory storage device; a pressure sensitive drawing surface integrated in the tablet device and adapted to display back to the user a result of an image drawn or written upon the drawing surface by application of pressure by the user, the display back to the user provided without the pressure sensitive drawing surface consuming electrical energy; a switch for erasing the image from the drawing surface by providing electrical energy to the drawing surface when the switch is actuated by a user; a data capture device for electronically capturing the image drawn or written upon the drawing surface into data for storing in a memory device; and a data interface for connecting the tablet device to an external device for communicating with the tablet device for receiving the data.

[0025] Further provided is a writing/drawing tablet device with data capture comprising: a pressure sensitive drawing surface including a first substrate having at least one liquid crystal layer and adapted to display back to the user a result of an image drawn or written upon the drawing surface by application of pressure by the user to the drawing surface to locally displace the liquid crystal to change its reflectance in a persistent manner; a pressure sensitive data capture surface including a second substrate for converting the image drawn or written upon the drawing surface into data; and a memory device

for storing the data, wherein the data is used for reproducing the image drawn or written upon the drawing surface.

[0026] Also provided are any of the above tablet devices where the device has any one or more of the following features:

[0027] Further comprising an additional display for displaying an image from the data;

[0028] Wherein the pressure sensitive data capture surface includes a resistive or inductive touchscreen device; and/or

[0029] Further comprising a processor for processing the data captured by the data capture device prior to storing the data in the memory device.

[0030] In addition is provided a method of generating and reproducing an image on a display device, with the method comprising the steps of:

[0031] -changing a reflectance of a portion of a chemical layer integrated in a drawing surface of the display device in response to a pressure being applied to the portion of the chemical layer for presenting an image on the drawing surface;

[0032] -converting the image on the drawing surface to data by also utilizing the applied pressure;

[0033] -storing the data in a memory device connected to the display device; and

[0034] -reproducing the image on a display different than the drawing surface.

[0035] Further provided is the above method having any one or more of the following features:



- [0036] wherein the presenting an image on the drawing surface does not require application of electrical power;
- [0037] wherein the image is reproduced on the display different than the drawing surface by utilizing the data stored in the memory device; and/or
- [0038] wherein the chemical layer includes a cholesteric liquid crystal material.

[0039] Also provided are additional embodiments of the invention, some, but not all of which, are described hereinbelow in more detail.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0040] The features and advantages of the examples of the present invention described herein will become apparent to those skilled in the art to which the present invention relates upon reading the following description, with reference to the accompanying drawings, in which:

[0041] Figure 1 shows a sketch of an embodiment of a writing/drawing tablet with a touch screen;

[0042] Figure 2 shows an embodiment of an optical scanning device illustration;

[0043] Figure 3 shows a block diagram for a writing/drawing tablet with dynamic data upload;

[0044] Figure 4 shows block diagram for a writing/drawing tablet with local memory;

[0045] Figure 5 shows a block diagram for a writing/drawing tablet with an ASIC;

[0046] Figure 6 shows a block diagram for a writing tablet having an additional Review Display; and

[0047] Figures 7(a) and 7(b) show a front and back view of an artist's conception of one embodiment of a writing tablet information recording device.

#### **DETAILED DESCRIPTION OF THE EXAMPLE EMBODIMENTS**

[0048] Provided are embodiments of an electronic writing/drawing tablet that has one or more of the desired features discussed above.

[0049] An electronic tablet is a design that can be based on Kent Displays' Reflex technology disclosed in US Patent 6,104,448 and in US Patent Applications serial numbers 12/152,862; 12/152,729; and 12/220,805, all incorporated herein by reference, and which can be utilized for various embodiments of a writing/drawing tablet having a data capture feature. The reflex technology disclosed in these references makes use of the special pressure sensitivity of certain materials, in particular in a cholesteric polymer composite system by converting the writing pressure into visible track on the tablet. Several consumer product designs have evolved and been considered as the ideal replacement for writing paper. Various embodiments of the invention disclose several ways to integrate memory function and/or data capture functions into such writing/drawing tablets to overcome the identified shortcomings.

[0050] One approach is to use a state-of-the-art data capture device, such as a touch screen, to capture the information being drawn on the tablet drawing surface. For example, a simple, low cost touch screen provided on the back of the writing/drawing surface can be utilized to capture the stylus movement by utilizing the capture features of the touch screen, as illustrated in Fig. 1, described in more detail below.

[0051] There are many touch input methods that can be used with the writing/drawing tablet as proposed herein to provide the data capture feature, such as are provided by capacitive, inductive, resistive, optical, acoustic, and other touch-input technologies. The touch screen can, for many applications, utilize relatively low resolution technology such as a resistive touch screen, and such a screen could even avoid the use of the traditional transparent conductor, ITO, because it can be provided behind the writing surface because the writing surface can be made flexible. Likewise a touch screen behind the writing surface is also possible with such other touch screen technologies such as the inductive method since the writing surface is transparent to the inductive stylus. The resistive and inductive methods are examples that will not interfere with the intended operation of the tablet.

[0052] The writing/drawing tablet with the integrated touch screen would not likely require extensive processing capability integrated into the device itself, (i.e., can have minimal “smarts”) for most such applications. The combination writing/drawing tablet drawing surface and touch screen would preferably be adapted to be connected to an external device, such as a computer or cell phone, for example, which could then provide any necessary processing capability (i.e., have all of the “smarts”). Alternatively, some processing capability can also be provided in the tablet itself in order to perform some rudimentary processing, such as A/D conversion, minor image processing, and/or memory management functions, for example. Features controlling the transmission of stored images to an external device, or for display on an integrated preview display as an additional display, can also be supported.

[0053] The connection between the tablet and the external device can be wired or wireless, as desirable for the intended application. Thus as examples, for a wired connection, a direct wired connection, or a USB or other serial port connection could be utilized, or even an Ethernet connection for some

embodiments. For wireless connectivity, a WiFi, Bluetooth, infrared, or other connection mechanism could be utilized. In some embodiments, both wired and wireless connections might be provided, although the desire to keep the cost of the tablet low and reduce power consumption might limit the number of features that one provides in some embodiments of the tablet.

[0054] For many applications, it is desirable to reduce the cost of the recordable writing/drawing tablet significantly by utilizing the processing capability of the external device whenever possible. Of course, the processing capability could be integrated into the tablet, if desired, when an external device is either not available, or does not have sufficient processing capability for the intended application, or to provide a more self-contained tablet. Thus, the tablet could have a processor (such as a microcontroller, CPU, or other type of processor) incorporated therein to provide sufficient processing in the device. Dedicated processors for implementing the desired interface (e.g., USB, Ethernet, WiFi, Bluetooth, etc.) could be utilized, and may be available off-the-shelf with either commercially available, or customized, software/firmware. A processor, A/D device, or other electronics might be provided to digitize the image drawn on the tablet, and such devices are known to be used with some touch screen applications.

[0055] Furthermore, the tablet might incorporate a memory device, such as RAM, EEPROM, a hard drive, or other data storage mechanism, to store images drawn on the display within the device for later download to a computer or other device. This could enable the device to store hundreds, thousands, or more images in the memory. Such memory devices might be removable, such as a USB drive or flash memory commonly available for digital photography and music storage, for example. A preferred embodiment of the tablet includes a slot for insertion of commercially available removable flash memory.

[0056] There are many data capture options, including many touch input methods, that can be used with writing tablets to obtain data capture functionality, such as pressure sensitive touch screens, inductive touch screens, optical touch screens, acoustic touch screens, capacitive touch screens, and others. The touch screen can be a relatively low resolution screen that may not even need to use the traditional transparent conductor, ITO, (because for this use it is provided behind the drawing surface, and thus transparency may not be necessary). The touch screen device would preferably have minimal “smarts” as discussed above, although processing can be provided to increase the functionality and/or flexibility of the implementation. The combination writing/drawing surface and touch screen would be connected to an external device such as a computer or cell phone, which would have all of the “smarts”, when processing was desired. The connection can be wired or wireless, as discussed above. The point is to reduce the cost of the recordable tablet by using the smarts in the external device as much as possible.

[0057] A preferred example embodiment utilizes a pressure sensitive resistive type touch screen for the data capture feature, whereby the location of the stylus is recorded by its location on a resistive pad provided on the back side of the drawing surface of the writing tablet, as illustrated in Figure 1. In Fig. 1, a stylus, 20, provides pressure to the electronic writing tablet drawing surface 10 including two flexible substrates, 11, each with transparent conductive electrodes, 12 located on the inner surface. A pressure sensitive cholesteric liquid crystal dispersion, 13, rests between the electrodes. Pressure from the stylus, 20, creates a smaller gap distance 18, compared to the relaxed distance 17, which causes the liquid crystal to flow and change the cholesteric texture from a transparent focal conic texture to a reflective, stable planar texture which becomes a visible image to the eye when contrasted on a dark, usually black background as provided by a light adsorbing layer, 30. Thus, the image is drawn on the writing surface and displayed to the user without the consumption of

electrical power, as the image is formed by the distortion of the liquid crystal caused by the stylus pressure, and the image is persistent due to the bistable nature of the liquid crystal.

[0058] Of course, in an alternative embodiment, the image could be provided as a negative of the above described process by providing a light reflective light background that becomes transparent in response to the stylus pressure under an applied voltage exposing a dark light absorbing background. Either embodiment can be used to display an image due to the contrast between the background and the portion of the liquid crystal that was deformed by the pressure, thereby producing the desired image.

[0059] The image is erased by applying voltage pulses to the electrodes 12, via the interconnects 14, such as disclosed in US Patent 6,104,448 and US Patent Applications 12/152,862 and 12/220,805, incorporated by reference. Thus, electrical power is required only for erasing the image and putting the liquid crystal back into a neutral state for receiving the next drawing image. There is little or no power consumption during the drawing phase using the above described embodiment. Alternative embodiments may utilize some electrical power for the drawing process, such as for various contrast improving functions, providing a negative mode, or partial erasing, for example, but in any case, it does not require any power to maintain a stable image on the display due to the bistable nature of the liquid crystal utilized for the device.

[0060] In the above described embodiment of the invention (see Fig. 1), a pressure sensitive touch screen, 40, is placed adjacent to the writing tablet 10 to provide an integrated writing and recording tablet 50. In the case of a pressure sensitive touch screen such as a resistive one, pressure from the stylus 20 is transferred through the writing pad 10 to the touch screen 40, indicating its position or location on the touch screen. The resistive data from the touch screen is transferred to digital recording electronics via electrodes 44. There can

be a plurality of electrodes 44 depending upon the type of resistive touch screen utilized. This particular embodiment is preferred because of its low cost, simplicity, and the fact that it can be made very thin and light in weight. A commercial touch screen can be used in this embodiment or it can be custom designed to be better integrated with the touch screen. Alternative embodiments can utilize other types of touch screen technologies, such as an inductive touchscreen when the tablet is paired with a stylus adapted for such a use, for example.

[0061] Another embodiment to capture the image using a data capture device other than a touch screen could use a 1D scanning image array, such as illustrated in Figure 2, which shows a top view and two different side views of the device. In Figure 2, the electronic tablet with scanner 100 is comprised of a tablet 101 on its mount 105 with a 1D optical scanner 102, which is drawn (swiped) by hand or electromechanically across the tablet. Suitable electronics 103, including, for example, a microcontroller, a battery, and an SD card, electronically captures and digitally records the image as the optical scanner 102 is swiped. This embodiment could be designed in as part of the tablet or manufactured and sold separately as, for example, an add-on feature.

[0062] In still another embodiment not requiring a touch screen technology, a 2D image optical sensor (such as might be utilized for a digital camera, for example) can be used to capture and digitally record the image from the front of the tablet. Alternatively, by placing a sensor behind the liquid crystal layer, the image can then be captured by monitoring the intensity of light being transmitted through the liquid crystal layer, thus capturing the image by the image sensor for transmission to the tablet electronics for storage and/or transmission to the external device.

[0063] In any of the methods and designs disclosed above, the captured data can be sent to a desktop PC, laptop, PDA, or cell phone via wireless or wire

link. Another option is to store the captured image on local flash memory, or internal memory, of the device itself. Several different designs for the inventive device to perform this function are described in more detail, hereinbelow.

[0064] With the consideration of the compactness integration, durability, low power, and convenience of use, any of the following embodiments of the tablet, among others, could be provided to capture the image drawn on the tablet on an external device:

[0065] **1. A Writing/Drawing Tablet with dynamic data upload:**

The general design block diagram of this example embodiment is shown in Fig 3. It includes a writing/drawing tablet 10, a touch screen 40, and associated electronic circuitry 200. The circuitry 200 consists of a general purpose microcontroller unit, MCU 205 MCU, a touch screen controller 201, tablet drive circuits 202, a battery, 203, flash memory 204, a USB port IC 206, and a blue tooth IC 207. The touch screen data capture device 40 is integrated with writing/drawing surface 10 to form a combined writing and recording tablet 50 as illustrated in Figure 1. All writing and drawing on the drawing surface 10 is sense by the data capture device 40 and converted by the data capture controller 201 into coordinate data which is then captured by the MCU 205. Then the data from the MCU 205 is sent by single data point, or group of data points, or one complete capture, through the USB port 206 or blue tooth port 207 to external device, such as PC, laptop, PDA or cell phone not shown in Figure 3. The image on the writing tablet is erased by voltage pulses supplied to driving circuit 202.

[0066] **2. A Writing/Drawing Tablet with local memory:** The general design of this example embodiment is shown in the block diagram in Fig 4. It includes a writing/drawing surface 10, a touch screen data capture device 40 and associated circuitry 300. Circuitry 300 includes, a general purpose MCU 205, a data capture controller 201, tablet drive circuits 202, a battery 203, flash memory 204, and an optional USB port 206. The flash memory 204 may be



removable, such as by using a USB flash drive or other types of removable flash memory commonly used in the computer industry, such as compact flash, memory stick, MicroSD, MMC, etc. or an internal hard drive such as might be used in a laptop computer, for example. The touch screen 40 is integrated with writing/drawing tablet 10 to form a combined writing/recording tablet 50, as illustrated in Figure 1. All writing or drawing on the drawing surface 10 is sensed by data capture device 40 and converted by the touch screen controller 201 into coordinate data and captured by the MCU 205. Typically, whole images are captured and stored in the local flash memory 204. The image files may then be transferred to external device, such as PC, laptop, PDA, or cell phone not show in Figure 4 through the USB port 206. This Flash memory 204 may be removed (such as an SD Card) to transfer data to an external device. Such device might also function as a USB drive, for example.

[0067] Furthermore, the images stored in the memory might be replayed by the tablet through an external display, or a review/preview display integrated with the tablet. For example, a scroll button could be provided that will scroll through the stored images and redraw them on the external/preview display, without downloading the entire set of images.

[0068] Various additional features could be utilized for additional embodiments, such as:

[0069] 1. ASIC: To further reduce the cost and improve reliability, the MCU 205, UBS port 206, touch screen controller 201, and driving circuits 202 can be replaced with one customized integrated circuit 400(ASIC), as illustrated in Fig. 5.

[0070] 2. Rechargeable Battery: The battery 203 in Figures 3, 4, 5, and 6 in the design could utilize a rechargeable Li-Poly battery (or other rechargeable technology) and/or solar cell, which could be used for charging the

battery. The Li-Poly battery can be charged by a solar cell or by a USB port, for example. Such a design might last for years with out any changes or replacement parts. It is a true green design.

[0071] 3. Resistive Touch Screen: Typical resistive touch screens are made with a flexible substrate and a glass substrate to support the touch action; however, in this application, a glass substrate is not necessary since the touch screen need not be transparent, and thus can be eliminated. The touch screen can be installed on the back of the writing/drawing tablets underneath the display layer(s) of the drawing surface, and the plastic housing at the bottom of the writing/drawing tablet can be utilized for support. Such design can also make the touch screen thin, light, and durable. Also in this example embodiment, the optical property of the touch screen does not matter, because the light need not travel through that layer. Other touch screen technologies that can be used underneath the tablet display layer include an inductive touch screen. The inductive technology uses a special pen (stylus) with a resonant circuit to sense the pen position. A capacitive touch screen, in contrast, would in most cases need to be applied over the display layer, and thus would require consideration of its light transmissive properties for it to be utilized for the drawing tablet.

[0072] Figure 7a shows an artistic illustration of an example of a commercially viable embodiment of the conceived device. The writing tablet drawing surface 50 is integrated with the touch screen and is encased in a housing 500 which further contains the associated electronic circuitry such as, for example, illustrated in block diagram 200 of Figure 3 or block diagram 300 of Figure 4. The space required for the circuitry is considerably reduced by use of a suitable ASIC chip 400 as diagramed in Figures 6 and 7, for example. An optional removable Flash memory slot 304 for inserting removable flash memory may be used to transfer images to a PC or other device for viewing or the images may be transferred directly by a cable 210 connecting the USB port of the

recording tablet to an external device 510 such as a PC or similar device with a display for viewing the image.

[0073] 4. Small Format Display: A display 220 can be added to the device, such as a small format display (such as 2.5" TFT, for example), for page review/preview, such as is illustrated in Figures 6 and 7b . Such a display could also be used to scroll through the images stored in the tablet.

[0074] 5. Button Interface: A simple user interface can be provided to allow for simple user functions. For example, a two or three actuator (such as pushbutton) design could be useful, with one actuator for activating the function of storing the image, and another actuator for erasing the image, and a third actuator for storing the image. Optionally, a single erase button could be utilized to store the data before erasing it. Or both the store and erase buttons might activate the same, or different, store functions. A scroll button may be provided, or one of the above actuators might be utilized for this purpose, such as by multiple activation of the actuator, or holding it down for a certain period of time, for example.

[0075] 6. Negative Mode: A negative drawing mode can be implemented in a manner discussed in U.S. patent application serial number 12/152,729 and incorporated herein by reference. In this mode, an image can be drawn using a stylus by applying a voltage  $V_W$  using a write circuit. Thus, in contrast to the normal modes discussed above, electrical power is utilized for this drawing mode. The voltage is applied for the duration of the stylus write; preferably,  $V_W$  is a continuous AC voltage or a sequence of bipolar pulses. The voltage is applied to patterned or unpatterned electrodes so that the entire display area of liquid crystal seen by the user of the writing tablet, has an electric field applied to it. The voltage  $V_W$  will drive that area of the cell to which it is applied to the focal conic texture; that is, areas of the cell under the stylus where

pressure is applied and cell gap is reduced. The planar texture in that area is driven to the focal conic texture. In the remainder of the cell where the cell gap is not disturbed, even though the electric field has been applied here, the material will remain in the planar texture, leaving a planar background for the focal conic writing. In other words, the liquid crystal material where the cell gap is undisturbed remains in the planar texture while the voltage  $V_w$  is applied to the electrodes and is not converted to the focal conic texture. Power can be removed after the drawing operation, with the image being retained on the drawing surface.

[0076] Note also that the color drawing feature described in the cited application could also be utilized for a drawing tablet with data capture. Also, selective erasure of portions of the drawing also described in that application, could also be utilized for the tablet with data capture features.

#### [0077] EXAMPLES

##### [0078] Example 1: Recording writing tablet with a resistive touch screen:

[0079] Resistive touch screens are commonly used in such applications as cell phones and various other touch screen monitors. A resistive touch screen is fabricated with two transparent flexible substrates stacked on top of one another and separated with a gap of a few microns. The inner surface of each of the substrates is coated with a transparent conducting material, usually indium tin oxide, ITO. When pressure is applied to the upper substrate with a pointed stylus or finger the top substrate electrical contact is made between the upper and lower substrate at the point where pressure is applied. When voltage is applied across the conductor of one of the substrates, say the upper substrate, a voltage divider is created. The coordinates of the stylus can be found by applying a voltage across one substrate's conductor in the Y direction and reading the voltage created by the voltage divider from the other substrate's

conductor to find the Y coordinate, and then applying a voltage across the other substrate's conductor in the X direction and reading the voltage created the voltage divider from the first substrate's conductor to find the X coordinate (see for example US Patent 6,178,048, incorporated by reference).

[0080] A prototype of a writing tablet information recording device was made by stacking a cholesteric pressure sensitive writing tablet on top of a resistive touch screen. The pressure sensitive writing screen used in the prototype was part number 1580001516B used in the Boogie Board™ writing tablet product of Improv Electronics, a company of Kent Displays, Inc., 343, Portage Blvd., Kent OH 44240. The resistive touch screen used was a 4-wire resistive touch screen, part number 400429, of Bergquist Touch Products, 301 Washington Street, Cannon Falls MN 55009. With the active area (5" X 7") of the pressure sensitive writing screen being slightly smaller than that of the resistive touch screen (6" X 8"), the cholesteric writing screen was held on top of the touch screen with tape around the edges of the writing screen. A four-wire resistive touch screen controller using a Texas Instruments MSP430F248 microcontroller was implemented following the Texas Instruments Application Report SLAA384 – February 2008 by N Brenner and Sullivan as obtained under URL: <http://focus.ti.com/lit/an/slaa384/slaa384.pdf> (Texas Instruments, P.O. Box 655303, Dallas TX 75365).

[0081] With the output of the touch screen controller connected to a PC via a serial port, it was observed that writing an image on the pressure sensitive writing tablet with a pointed stylus would also trace the same image on the PC screen when running the PC application included in SLAA384. The image created on the PC screen could be saved using the 'Print Screen' functionality of the PC to copy the application window to the clipboard and then paste the window into a drawing application such as Paint, from where it could be saved for later recall.

[0082] Example 2: Recording writing table with inductive touch screen:

[0083] As described, for example, in US Patent 4,786,765 herein incorporated by reference, inductive touch screens consists of special stylus that includes the tuned circuit of an inductor and capacitor connected in series. The stylus is without connection to a power supply or other device but has a resonant frequency approximately equal to the frequency of a wave derived from a coil arrangement in a tablet. The position of the stylus on the tablet is detected by coupling energy induced in the stylus back to the tablet.

[0084] A prototype writing tablet information recording device was fabricated by stacking a cholesteric pressure sensitive writing tablet on top of an inductive touch screen module of Wacom Co. Ltd. The cholesteric pressure sensitive writing screen used in the prototype was part number 1580001516B used in the Boogie Board™ writing tablet product of Improv Electronics, a company of Kent Displays, Inc., 343, Portage Blvd., Kent OH 44240. The inductive touch screen used was part number SU5E-13W01AS-01X of Wacom Co. Ltd., 2-510-1 Toyonodai, Otone-machi, Kitasaitama-gun, Saitama, 349-1148, JAPAN. As in Example 1, a Texas Instrument MSP430F248 microcontroller was used to interface between the touchscreen and a PC application which displayed the image drawn on the display. In this case the microcontroller interfaced to a Wacom touch controller included with the touchscreen which controlled the touch screen and provided touch coordinates. The cholesteric pressure sensitive writing screen was laid over the Wacom touch sensitive module and held in place with tape and alternatively with pressure. The MSP430 F248 microcontroller relayed touch coordinates from the touch screen to a PC application similar to that in SLAA384 via a serial port.

[0085] It was observed that with the stylus provided by Wacom with the inductive touch screen one could write an image on the cholesteric tablet while the image was being digitized, recorded and displayed on the PC simultaneously.

An advantage of the inductive touch screen over the resistive touch screen of Example 1 was found in that the tablet only responded to the pressure of the stylus and not, for example, on the hand resting on the tablet.

[0086] Example 3: Cholesteric writing tablet overlaying a Bamboo™ Pen Tablet:

[0087] The concept of coupling a cholesteric writing tablet with a touch sensitive device to digitally record information was demonstrated by use of a commercial Bamboo™ Pen Tablet of Wacom Co. Ltd. A Bamboo™ Pen tablet is a device that works with a standard computer, laptop or desktop. Using the inductive touch screen technology described in Example 2, the Bamboo™ Pen functions as a tablet to display hand written information or drawings on the computer screen with the special inductive stylus. A problem with the device is that one cannot see the hand writings on the tablet device itself. Adding the cholesteric tablet to the Bamboo™ Pen Tablet corrects this problem. In order to demonstrate this feature, a cholesteric pressure sensitive writing screen, part number 1580001516B of Improv Electronics was overlaid on the Bamboo™ Tablet and held in place with pressure. It was demonstrated that writing an image on the cholesteric tablet would also create the same image on the computer screen.

[0088] Many other example embodiments of the invention can be provided through various combinations of the above described features. Although the invention has been described hereinabove using specific examples and embodiments, it will be understood by those skilled in the art that various alternatives may be used and equivalents may be substituted for elements and/or steps described herein, without necessarily deviating from the intended scope of the invention. Modifications may be necessary to adapt the invention to a particular situation or to particular needs without departing from the intended scope of the invention. It is intended that the invention not be limited to the

particular implementations and embodiments described herein, but that the claims be given their broadest reasonable interpretation to cover all novel and non-obvious embodiments, literal or equivalent, disclosed or not, covered thereby.



**CLAIMS**

What is claimed is:

- 1           1.       A writing/drawing tablet device with data capture comprising:  
2           a drawing surface integrated in the tablet and adapted to display back to  
3           the user a result of an image drawn or written upon said drawing  
4           surface by the user, and  
5           a data capture device for capturing said image drawn or written upon said  
6           drawing surface for storing in a memory device, wherein  
7           said display back to the user of the image drawn or written upon said  
8           drawing surface does not require the consumption of electrical  
9           power from any power source.
- 1           2.       The tablet device of claim 1, wherein said drawing surface  
2           comprises an LCD for displaying back the image drawn or written on the drawing  
3           surface.
- 1           3.       The tablet device of claim 2, wherein said LCD is a cholesteric  
2           LCD.
- 1           4.       The tablet device of claim 1, wherein said drawing surface is a  
2           pressure sensitive drawing surface and wherein said image is drawn or written  
3           upon said drawing surface by applying pressure to said drawing surface.
- 1           5.       The tablet device of claim 4, wherein said pressure is applied to  
2           said drawing surface using a stylus.
- 1           6.       The tablet device of claim 4, wherein said data capture device is  
2           adapted to convert pressure points to electrical signals for capturing said image

3 drawn or written upon said drawing surface into said memory device.

1 7. The tablet device of claim 4, wherein said data capture device  
2 comprises a touch screen device utilized for capturing said image drawn or  
3 written upon said drawing surface into said memory device.

1 8. The tablet device of claim 1, wherein said data capture device  
2 comprises an optical scanning device that is utilized for capturing said image  
3 drawn or written upon said drawing surface into said memory device.

1 9. The tablet device of claim 1, wherein said data capture device  
2 comprises a touch screen device utilized for capturing said image drawn or  
3 written upon said drawing surface into said memory device.

1 10. The tablet device of claim 1, wherein said memory device is a flash  
2 memory or RAM comprised in said tablet device.

1 11. The tablet device of claim 1, further comprising a data interface,  
2 wherein said memory device is included in an external device communicating  
3 with said tablet device utilizing said data interface for capturing said image.

1 12. The tablet device of claim 1, further comprising a data interface,  
2 wherein said memory device is included in an external device communicating  
3 with said tablet device utilizing said data interface for capturing said image,  
4 wherein said memory device is used to reproduce the image on a remote display  
5 included with said external device.

1 13. The tablet device according to claim 1, further comprising an  
2 additional display for displaying a replica of the image the captured in said  
3 memory device.

1           14.    The tablet device of claim 13, wherein said table device is adapted  
2 such that additional images previously stored in said memory device can be  
3 displayed on said additional display when selected by the user for such display.

1           15.    The tablet device according to claim 14, further comprising a  
2 rechargeable battery for providing power to said tablet device for powering said  
3 additional display.

1           16.    The tablet device of claim 15, further comprising a solar cell for  
2 charging said rechargeable battery.

1           17.    The tablet device according to claim 15, further comprising an  
2 erase actuator, such that activation of the erase actuator by the user erases the  
3 image drawn or written upon said drawing surface by application of a voltage to  
4 said drawing surface.

1           18.    The tablet device according to claim 1, further comprising an erase  
2 actuator, such that activation of the erase actuator by the user erases at least a  
3 portion of the image drawn or written upon said drawing surface by application of  
4 a voltage to a corresponding portion of the drawing surface.

1           19.    The tablet device according to claim 1 wherein said pressure  
2 sensitive data capture surface includes a resistive or inductive touchscreen.

1           20.    The tablet device according to claim 1, further comprising a  
2 processor for processing the image captured by said data capture device prior to  
3 storing said image in the memory device.

1           21.    The tablet device according to claim 1, wherein said memory

2 device is included in said tablet.

1 22. The tablet device according to claim 21, further comprising a  
2 memory interface wherein said memory device communicates with said tablet via  
3 said memory interface and said memory device is removable from said tablet by  
4 a user.

1 23 A writing/drawing tablet device with data capture comprising:  
2 a power supply for powering said device;  
3 a memory storage device;  
4 a pressure sensitive drawing surface integrated in said tablet device and  
5 adapted to display back to the user a result of an image drawn or  
6 written upon said drawing surface by application of pressure by the  
7 user, said display back to the user provided without said pressure  
8 sensitive drawing surface consuming electrical energy;  
9 a switch for erasing said image from said drawing surface by providing  
10 electrical energy to said drawing surface when said switch is  
11 actuated by a user;  
12 a data capture device for electronically capturing said image drawn or  
13 written upon said drawing surface into data for storing in a memory  
14 device; and  
15 a data interface for connecting said tablet device to an external device for  
16 communicating with said tablet device for receiving said data.

1 24. The writing table according to claim 23, wherein a voltage is applied  
2 to at least a portion of said pressure sensitive drawing surface during said display  
3 back of the image to the user.

1 25. A writing/drawing tablet device with data capture comprising:

2 a pressure sensitive drawing surface including a first substrate having at  
3 least one liquid crystal layer and adapted to display back to the  
4 user a result of an image drawn or written upon said drawing  
5 surface by application of pressure by the user to said drawing  
6 surface to locally displace said liquid crystal to change its  
7 reflectance in a persistent manner;

8 a pressure sensitive data capture surface including a second substrate for  
9 converting said image drawn or written upon said drawing surface  
10 into data; and

11 a memory device for storing said data, wherein said data is used for  
12 reproducing said image drawn or written upon said drawing  
13 surface.

1 26. The tablet device according to claim 25 further comprising an  
2 additional display for displaying an image from said data.

1 27. The tablet device according to claim 25 wherein said pressure  
2 sensitive data capture surface includes a resistive or inductive touchscreen  
3 device.

1 28. The tablet device according to claim 25, further comprising a  
2 processor for processing the data captured by said data capture device prior to  
3 storing said data in the memory device.

1 29. A writing/drawing tablet device with data capture comprising:  
2 a power supply for powering said device;  
3 a memory storage device;  
4 a pressure sensitive drawing surface including a first substrate having at  
5 least one liquid crystal layer and adapted to display back to the  
6 user a result of an image drawn or written upon said drawing

7 surface by application of pressure by the user to said drawing  
8 surface to locally displace said liquid crystal to change its  
9 reflectance in a persistent manner without any substantial  
10 consumption of electrical power;  
11 a switch for erasing said image from said drawing surface by providing  
12 electrical energy to said drawing surface when said switch is  
13 actuated by a user;  
14 a data capture device for electronically capturing said image drawn or  
15 written upon said drawing surface into data for storing in a memory  
16 device; and  
17 a data interface for connecting said tablet device to an external device for  
18 communicating with said tablet device for receiving said data.

1 30. A method of generating and reproducing an image on a display  
2 device, said method comprising the steps of:  
3 changing a reflectance of a portion of a chemical layer integrated in a  
4 drawing surface of said display device in response to a pressure  
5 being applied to the portion of the chemical layer for presenting an  
6 image on said drawing surface;  
7 converting said image on said drawing surface to data by also utilizing  
8 said applied pressure;  
9 storing said data in a memory device connected to said display device;  
10 and  
11 reproducing said image on a display different than said drawing surface.

1 31. The method of claim 30, wherein said presenting an image on said  
2 drawing surface does not require application of electrical power.

1 32. The method of claim 30, wherein said image is reproduced on the  
2 display different than said drawing surface by utilizing said data stored in the

3 memory device.

1 33. The method of claim 30, wherein said chemical layer includes a  
2 cholesteric liquid crystal material.

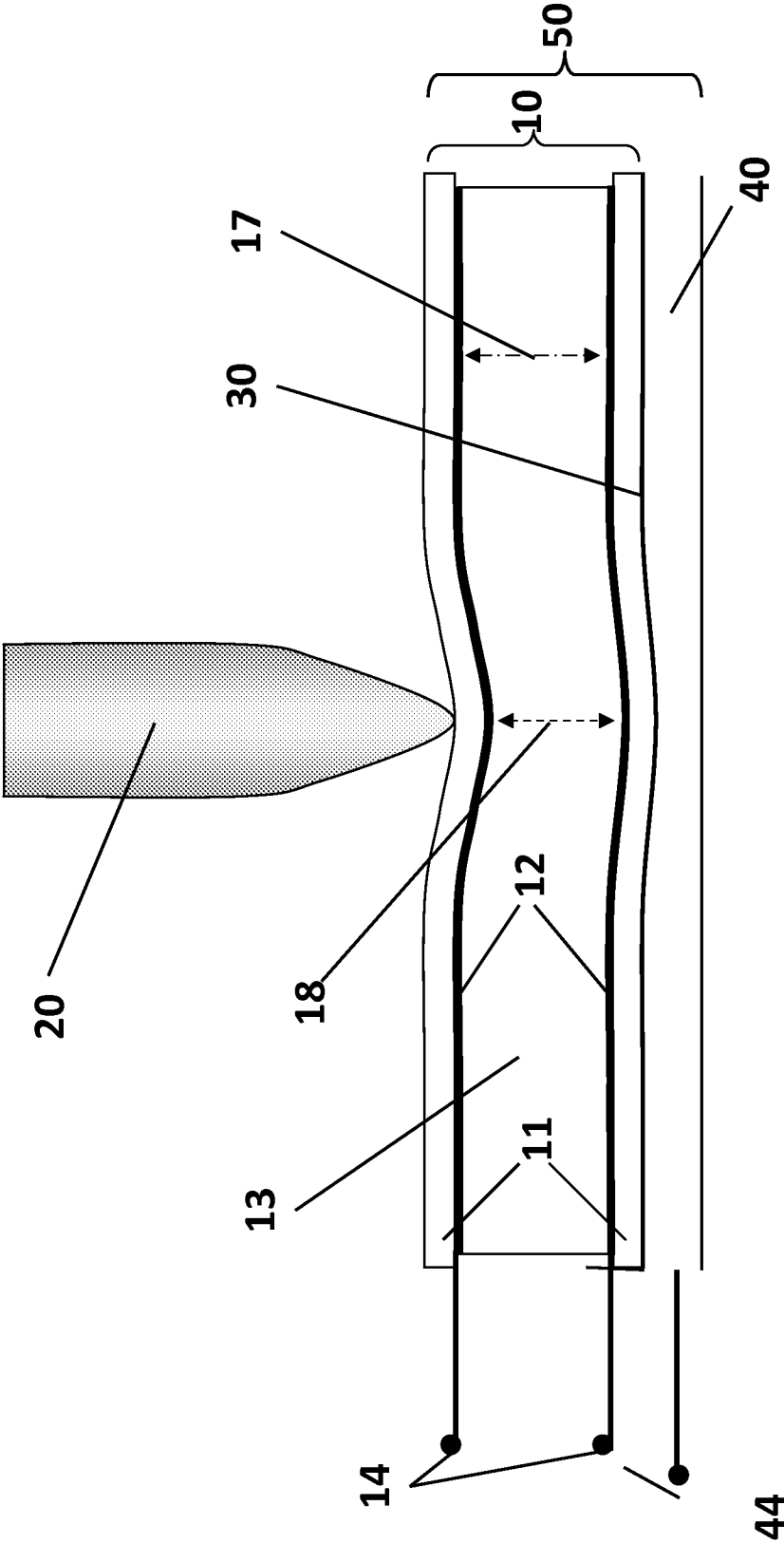


Figure 1



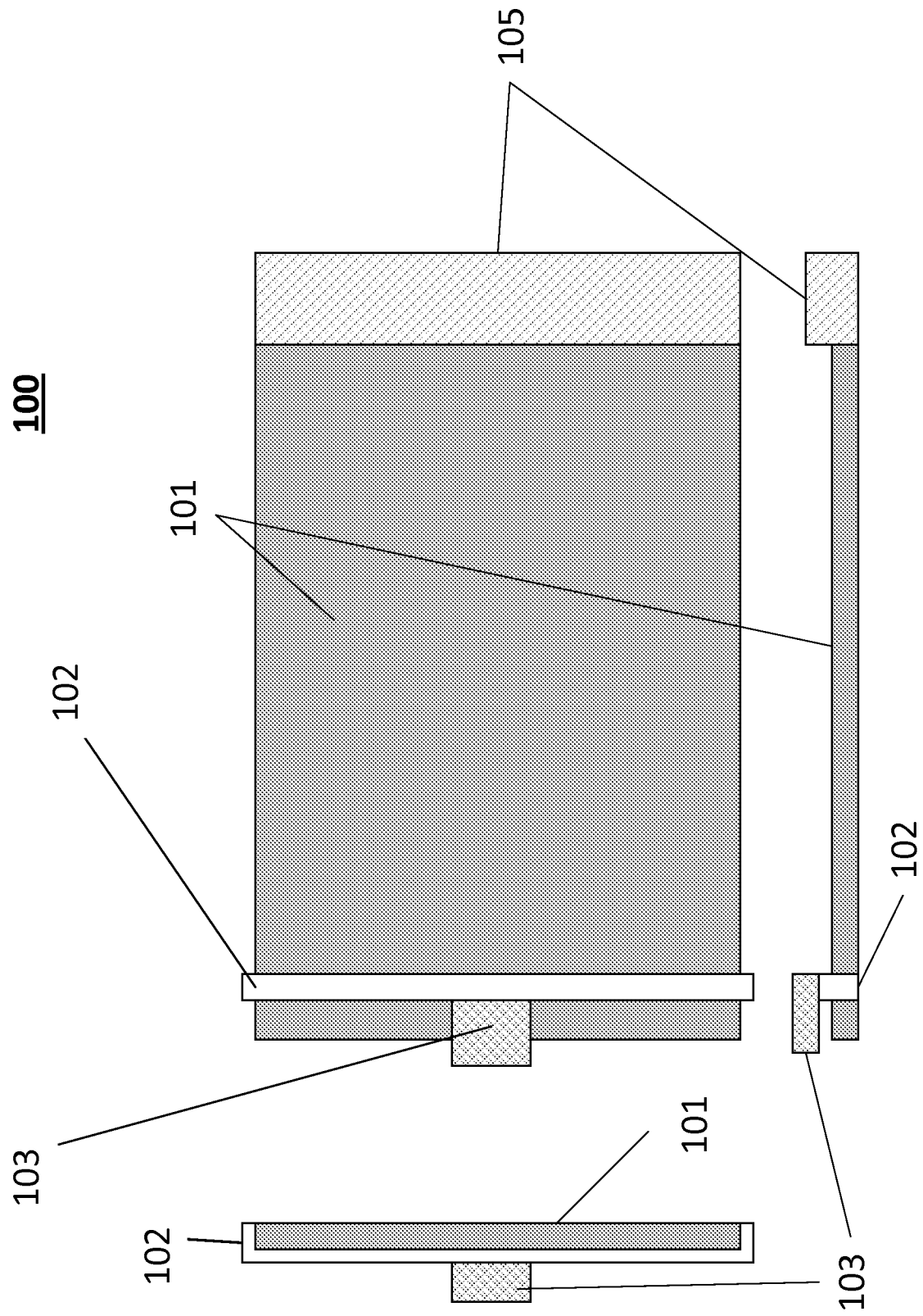


Figure 2

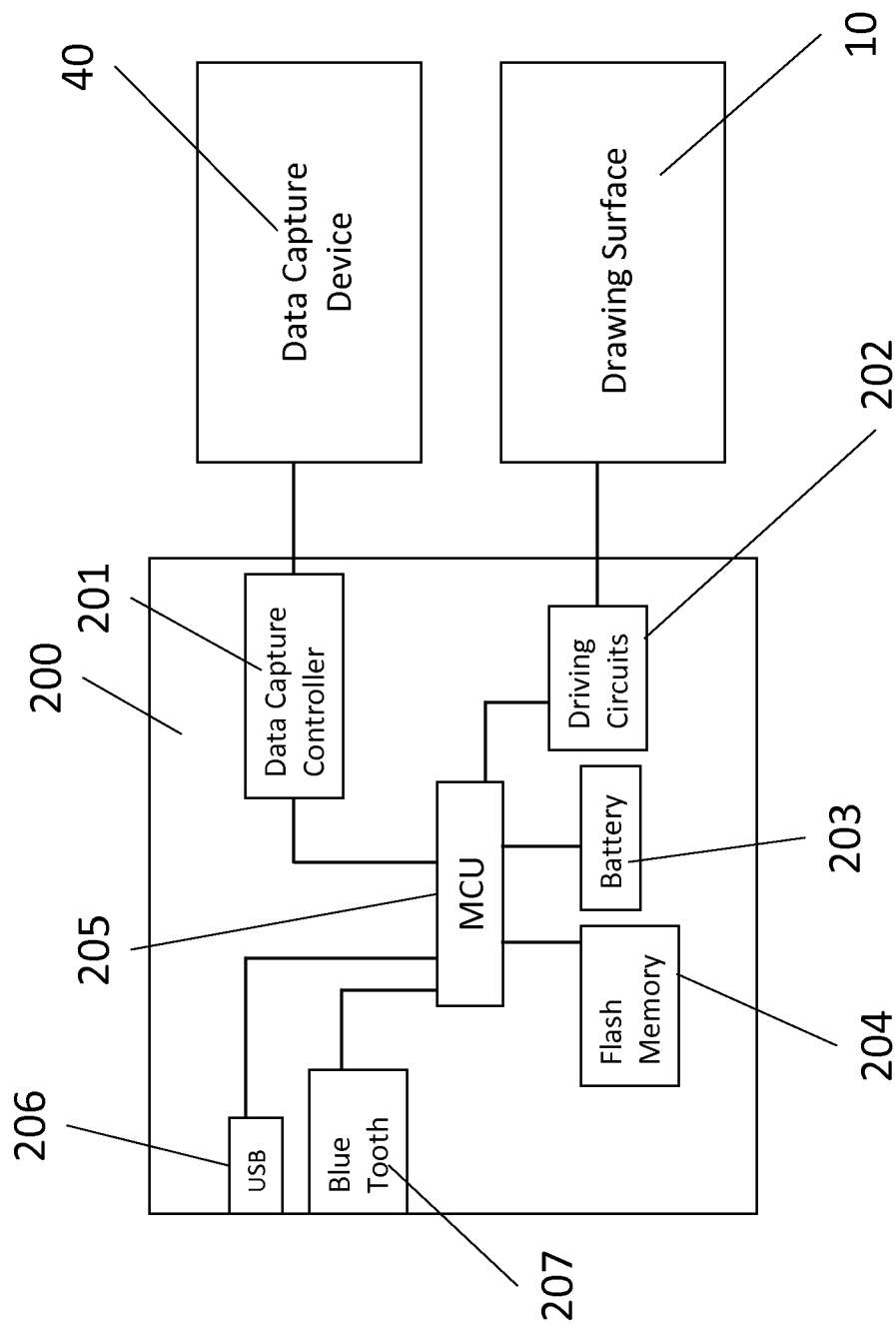


Figure 3

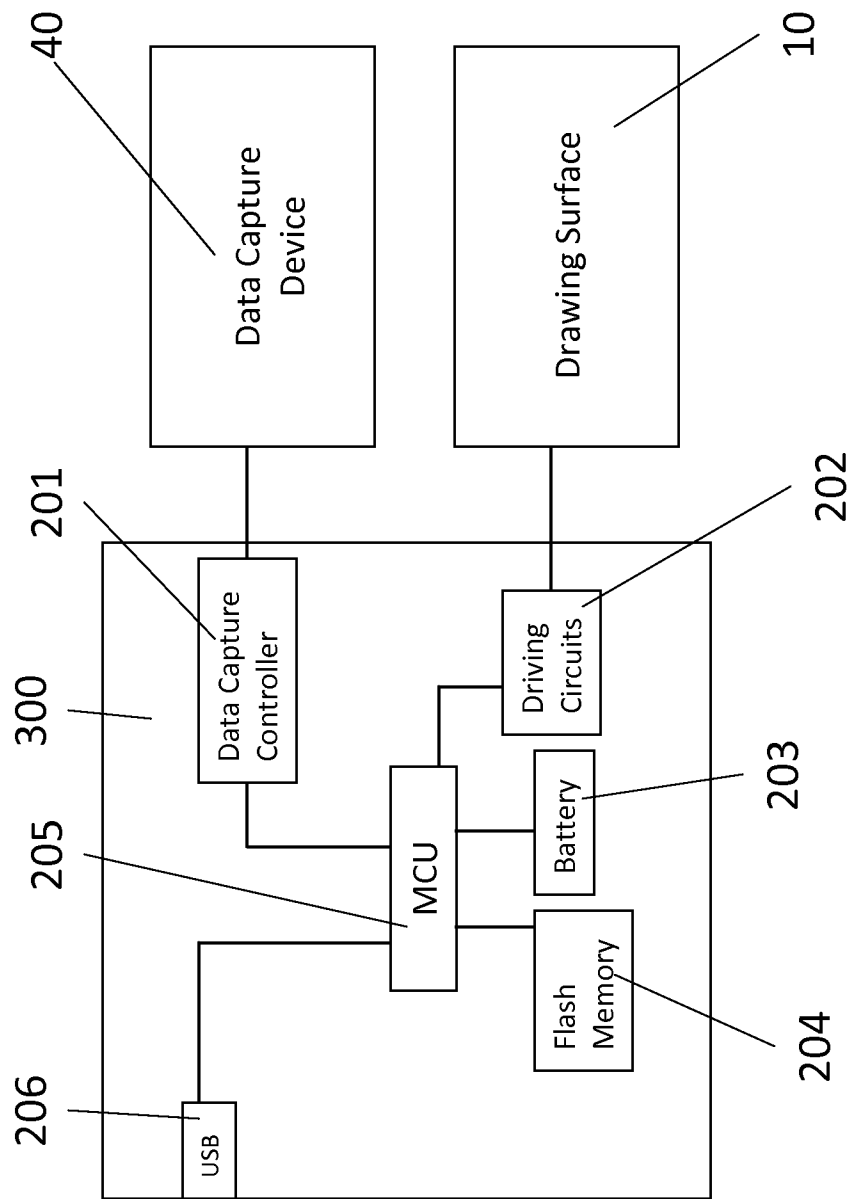


Figure 4

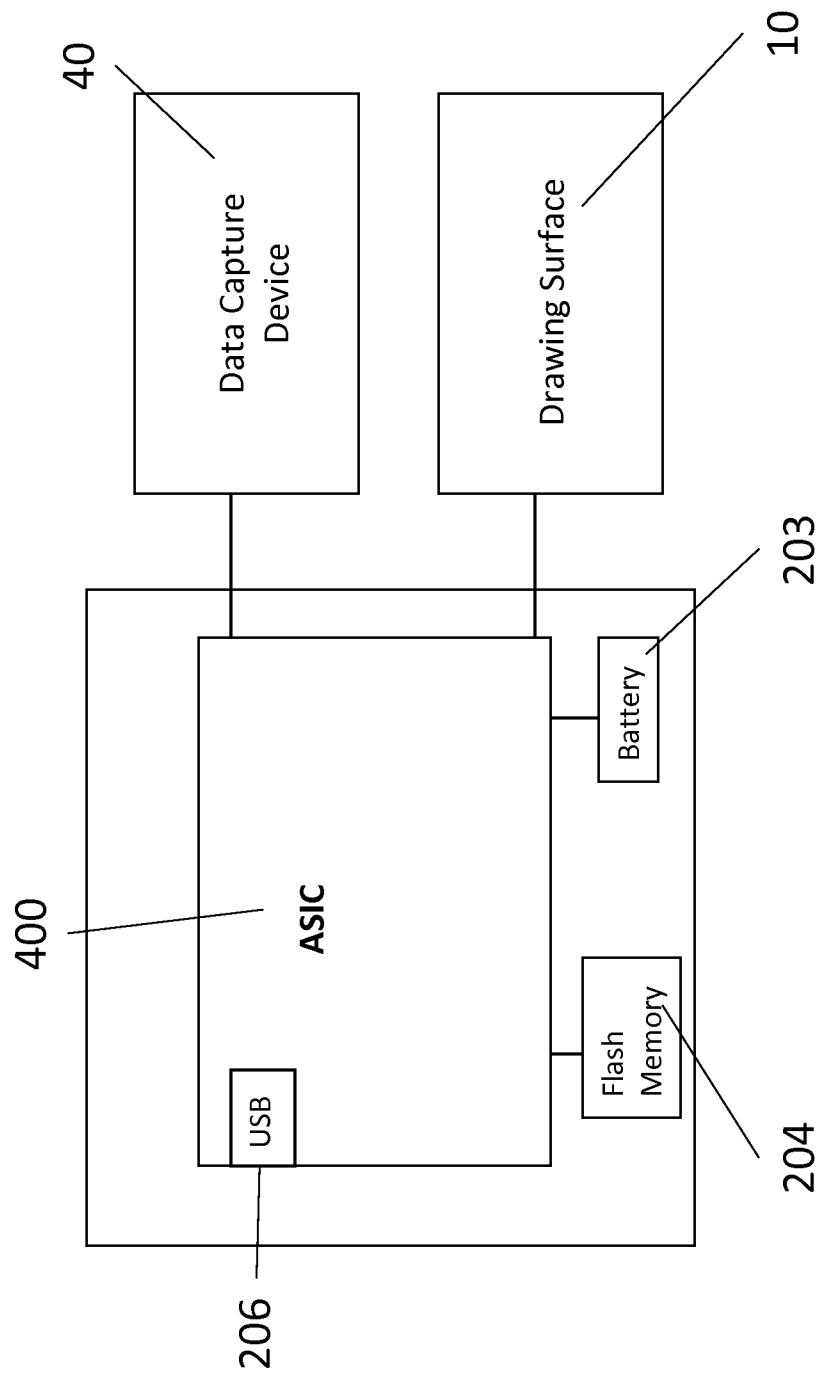


Figure 5

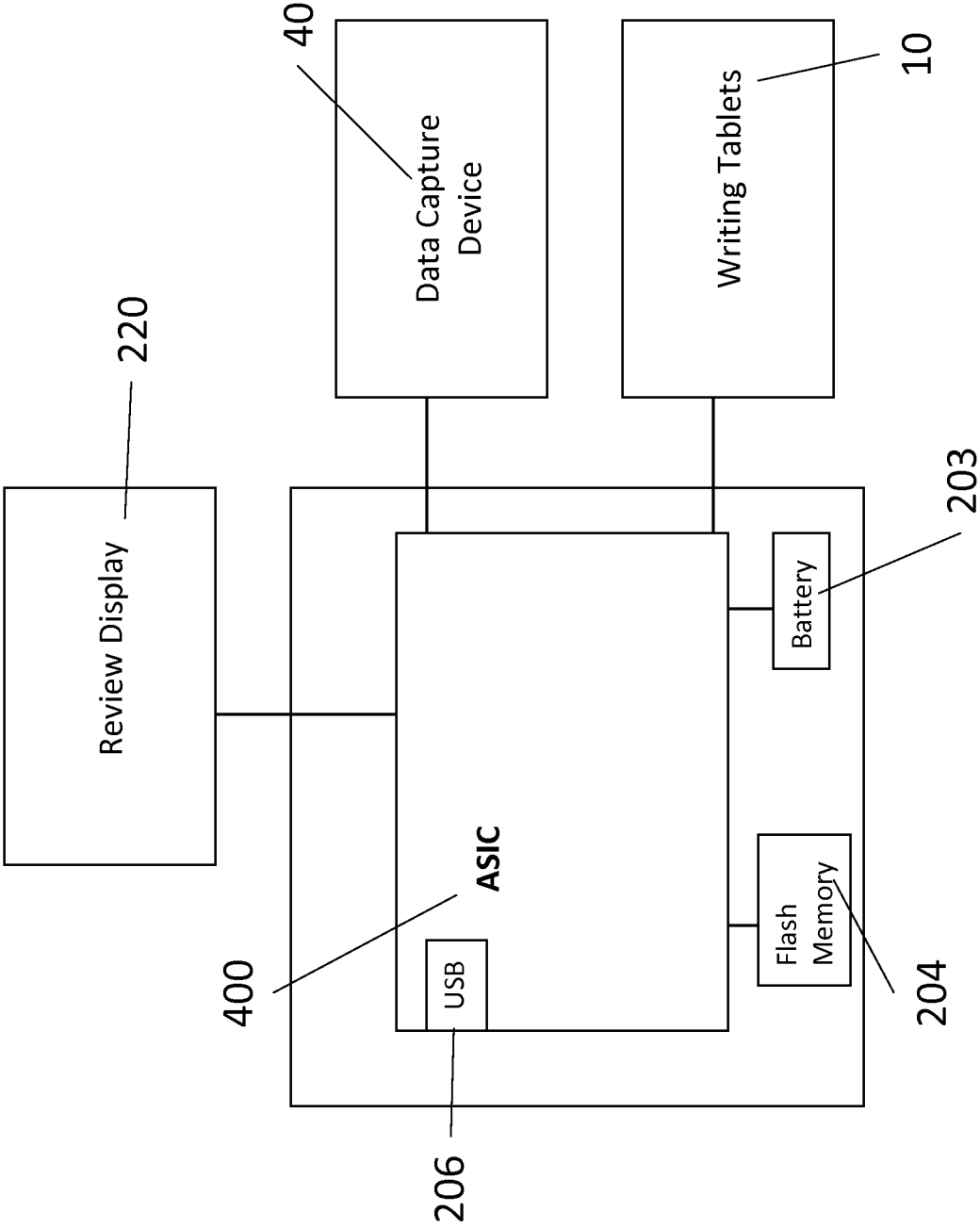


Figure 6

7/7

