patch connected to a border area through one or more yVcom lines running to the border area of touch screen **600** for enabling all patches in a particular row to be connected together through metal traces (not shown in FIG. **6**A) running in the border areas. These metal traces can be routed to a small area on one side of touch screen **600** and connected to a flex circuit **602**. As shown in the example of FIG. **6**A, the patches forming the rows can be formed, by selective placement of breaks in xVcom lines and yVcom lines, for example, in a generally pyramid-shaped configuration. In FIG. **6**A, for example, the patches for rows **1-3** between columns a and b are arranged in an inverted pyramid configuration, while the patches for rows **4-6** between columns a and b are arranged in an upright pyramid configuration.

[0099] FIG. **6**B illustrates a partial view of example touch screen **600** including metal traces **604** and **606** running in the border areas of the touch screen according to embodiments of the invention. Note that the border areas in FIG. **6**B are enlarged for clarity. Each column a-h can include extended yVcom line(s) **608** that allows the column to be connected to a metal trace through a via (not shown in FIG. **6**B). One side of each column includes staggered edges **614** and notches **616** designed to create separate sections in each column. Each row patch **1-6** can include extended yVcom line(s) **610** that allows the patch to be connected to a metal trace through a via (not shown in FIG. **6**B). yVcom lines **610** can allow each patch in a particular row to be self-connected to each other. Because all metal traces **604** and **606** are formed on the same layer, they can all be routed to the same flex circuit **602**.

[0100] If touch screen **600** is operated as a mutual capacitance touch screen, either the columns a-h or the rows **1-6** can be driven with one or more stimulation signals, and fringing electric field lines can form between adjacent column areas and row patches. In FIG. **6**B, it should be understood that although only electric field lines **612** between column a and row patch **1** (a-**1**) are shown for purposes of illustration, electric field lines can be formed between other adjacent column and row patches (e.g. a-**2**, b-**4**, g-**5**, etc.) depending on what columns or rows are being stimulated. Thus, it should be understood that each column-row patch pair (e.g. a-**1**, a-**2**, b-**4**, g-**5**, etc.) can represent a two-region touch pixel or sensor at which charge can be coupled onto the sense region from the drive region. When a finger touches down over one of these touch pixels, some of the fringing electric field lines that extend beyond the cover of the touch screen are blocked by the finger, reducing the amount of charge coupled onto the sense region. This reduction in the amount of coupled charge can be detected as part of determining a resultant "image" of touch. It should be noted that in mutual capacitance touch screen designs as shown in FIG. **6**B, no separate reference ground is needed, so no second layer on the back side of the substrate, or on a separate substrate, is needed.

[0101] Touch screen **600** can also be operated as a self-capacitance touch screen. In such an embodiment, a reference ground plane can be formed on the back side of the substrate, on the same side as the patches and columns but separated from the patches and columns by a dielectric, or on a separate substrate. In a self-capacitance touch screen, each touch pixel or sensor has a self-capacitance to the reference ground that can be changed due to the presence of a finger. In self-capacitance embodiments, the self-capacitance of columns a-h can be sensed independently, and the self-capacitance of rows **1-6** can also be sensed independently.

[0102] FIG. **6**C illustrates an example connection of columns and row patches to the metal traces in the border area of the touch screen according to embodiments of the invention. FIG. **6**C represents "Detail A" as shown in FIG. **6**B, and shows column "a" and row patches **4-6** connected to metal traces **618** through yVcom lines **608** and **610**. Because yVcom lines **608** and **610** are separated from metal traces **618** by a dielectric material, vias **620** formed in the dielectric material allow the yVcom lines to connect to the metal traces. The metal traces **618** can be formed in the same layer as the yVcom lines. In this case, there would be no additional process steps, and the touch traces can be routed in the same M**1** and M**2** layers that are conventional in LCD'S, also sometimes referred to as "gate metal" and "source/drain metal" . Also, the dielectric insulation layer can be referred to as a "inner layer dielectric" or "ILD".

[0103] As shown in FIG. **6**C, column edges **614** and row patches **4-6** can be staggered in the x-dimension because space should be made for the touch pixels containing yVcom lines **610** connecting row patches **4** and **5**. (It should be understood that row patch **4** in the example of FIG. **6**C is really two patches stuck together.) To gain optimal touch sensitivity, it can be desirable to balance the area of the regions in touch pixels a-**6**, a-**5** and a-**4**. However, if column "a" was kept linear, row patch **6** can be slimmer than row patch **5** or **6**, and an imbalance would be created between the regions of touch pixel a-**6**.

[0104] FIG. **7** illustrates a top view of an example column and adjacent row patches according to embodiments of the invention. It can be generally desirable to make the mutual capacitance characteristics of touch pixels a-**4**, a-**5** and a-**6** relatively constant to produce a relatively uniform z-direction touch sensitivity that stays within the range of touch sensing circuitry. Accordingly, the column areas a_4, a_5 and a_6 should be about the same as row patch areas **4**, **5** and **6**. To accomplish this, column section a_4 and a_5, and row patch **4** and **5** can be shrunk in the y-direction as compared to column section a**6** and row patch **6** so that the area of column segment a_4 matches the area of column segments a_5 and a_6. In other words, touch pixel a_4-**4** will be wider but shorter than touch pixel a_6-**6**, which will be narrower but taller.

[0105] Because the touch pixels or sensors can be slightly skewed or misaligned in the x-direction, the x-coordinate of a maximized touch event on touch pixel a-**6** (e.g. a finger placed down directly over touch pixel a-**6**) can be slightly different from the x-coordinate of a maximized touch event on touch pixel a-**4**, for example. Accordingly, in embodiments of the invention this misalignment can be de-warped in a software algorithm to re-map the touch pixels and remove the distortion.

[0106] Although a typical touch panel grid dimension can have touch pixels arranged on 5.0 mm centers, a more spread-out grid having about 6.0 mm centers, for example, can be desirable to reduce the overall number of electrical connections in the touch screen. However, spreading out the sensor pattern can cause erroneous touch readings.

[0107] FIG. **8**A is an example plot of an x-coordinate of a finger touch versus mutual capacitance seen at a touch pixel for a two adjacent touch pixels a-**5** and b-**5** in a single row having wide spacings. In FIG. **8**A, plot **800** represents the mutual capacitance seen at touch pixel a-**5** as the finger touch moves continuously from left to right, and plot **802** represents the mutual capacitance seen at touch pixel b-**5** as the finger touch moves continuously from left to right. As expected, a