[0087] 1. Single surface arrays of pads printed on one sensing layer where the pattern is fundamentally symmetrical. For example, square arrays of pads or hexagonal arrays of circles.

[0088] 2. As above but where the array is asymmetrical such as the 'Backgammon grid'.

[0089] 3. Dual surface sensors where two orthogonal arrays are printed on two different layers and sandwiched together. The top layer must provide gaps through which the bottom sensor can see. A preferred embodiment of a construction method for an orthogonal screen is described with the aid of diagrams in FIGS. **23-24**.

[0090] We now describe the location geometry for a single surface symmetrical array.

[0091] Simplified location geometry. See FIG **8**. Since xa (offset) and s (sensor spacing) are known, using simple Pythagorean law and solving for xf (finger position horizontally) we have

$$xf = \frac{a^2 - b^2 + s^2}{2s} + xa$$

[0092] This form of calculation generalises into two dimensions. Using similar trigonometric principles, and assuming the thickness dimension z (of e.g. glass, dielectric constant 4, assumed normalised to the corresponding thickness of air, dielectric constant 1, by a factor of ¼) is a constant we have for instance:

$$yf = \frac{a^2 - b^2 + s^2}{2s} + ya$$

[0093] For a hexagonal array, e.g. see **FIG. 9**,

$$xf = \frac{a^2 - b^2 + s^2}{2s} \cos 30^\circ + xa$$

[0094] although this calculation can be done by several alternative methods.

[0095] However, things are not that simple. The sensor response is not, in fact, linear with distance. It follows a law approximating to

$$\text{response} = \frac{1}{distance^n} \text{ where } 1 < n < 2$$

[0096] or in more practical terms this can be considered as follows. Interpolation of touch position for capacitive sensor pads can be improved by calibration, by normalising/equalizing the capacitance detected from each sensor pad and/or by utilising a (third) dimension angled (e.g. perpendicular) to the area containing the sensor pads. Capacitance is related to the distance between finger (tip) and sensor pad by a non-linear equation:

$$\text{capacitance} = k_1 \frac{a}{d} + k_2 \frac{a}{d} 2$$

[0097] where

[0098] a=effective area of finger and

[0099] d=distance from finger to sensor pad

[0100] and may be determined on calibration by creating a digital "look-up" table (corresponding to a graph) by using a standard "finger tip" (a plate). In the equation, the dimension a is the area of a flat plate having the same capacitance effect as the curved finger tip.

[0101] This is then further complicated by the glass/air interface and the fact that human fingers are not uniformly spherical metal objects—they are possessed of variable shape, cross-section and conductivity. The resulting nonlinear equation can be used to linearise the position of the finger or in a microprocessor the relinearisation mapping can be stored as a lookup table in a digital memory, e.g. an EPROM or E^2PROM, usually after calibration with a test "finger" (equivalent plate) in various positions when the keypad is in situ e.g. on a window.

[0102] A preferred embodiment of an interpolation method is described with the aid of **FIG. 25**, as applied to providing means for interpolation from an array of activated sensory elements (the said sensor pads).

[0103] Palm Rejection

[0104] The grid of row and column wires is affected dramatically by the touch of a finger due to the capacitive snap effect as air is excluded from under the finger tip. However the palm and knuckles, even though they are a considerable distance from the finger tip, are large and will have some effects on the rows and columns of the grid. Unfortunately due to the asymmetric nature of the human hand the palm is generally offset from the centre of the finger tip and therefore introduce an error in the calculated position.

[0105] In general, since the effect due to the finger tip is localised to two wires while the palm affects many wires at a distance a means of determining pain, offset can be found by using more wires in the grid.

[0106] A simple way of determining palm effect is look at the second adjacent wires i.e. two away from the most touched wire rather than one away from the most touched wire and calculating a linear interpolated position as described above. This method produces a new estimated point offset from the first adjacent point by an amount proportional to the palm effect. This offset can be multiplied by a known constant and used to correct the estimated position. In practice, this method suffers from noise as well as only being valid in the centre of the grid. There are however more generalisable solutions to this problem which are described below.

[0107] Firstly, a solution of simultaneous equations: In the linear interpolation problem above, two data points are used to find two unknowns namely m and c in a generalised