[0044] To still even further achieve the objects, the present invention comprises a method for choosing what kinds of input signals will be generated and sent to an electronic or electromechanical device in response to tapping or sliding of fingers on a multi-touch surface, the method comprising the following steps: identifying each contact on the surface as either a thumb, fingertip or palm; measuring the times when each hand part touches down and lifts off the surface; forming a set of those fingers which touch down from the all finger floating state before any one of the fingers lifts back off the surface; choosing the kinds of input signals to be generated by further distinctive motion of the fingers from the combination of finger identities in the set; generating input signals of this kind when further distinctive motions of the fingers occur; forming a subset any two or more fingers which touch down synchronously after at least one finger has lifted back off the surface; choosing a new kinds of input signals to be generated by further distinctive motion of the fingers from the combination of finger identities in the subset; generating input signals of this new kind when further distinctive motions of the fingers occur; and continuing to form new subsets, choose and generate new kinds of input signals in response to liftoff and synchronous touchdowns until all fingers lift off the surface.

[0045] To further achieve the objects, the present invention comprises a method for continuing generation of cursor movement or scrolling signals from a tangential motion of a touch device over a touch-sensitive input device surface after touch device liftoff from the surface if the touch device operator indicates that cursor movement continuation is desired by accelerating or failing to decelerate the tangential motion of the touch device before the touch device is lifted, the method comprising the following steps: measuring, storing and transmitting to a computing device two or more representative tangential velocities during touch device manipulation; computing and storing a liftoff velocity from touch device positions immediately prior to the touch device liftoff; comparing the liftoff velocity with the representative tangential velocities, and entering a mode for continuously moving the cursor if a tangential liftoff direction approximately equals the representative tangential directions and a tangential liftoff speed is greater than a predetermined fractional multiple of representative tangential speeds; continuously transmitting cursor movement signals after liftoff to a computing device such that the cursor movement velocity corresponds to one of the representative tangential velocities; and ceasing transmission of the cursor movement signals when the touch device engages the surface again, if comparing means detects significant deceleration before liftoff, or if the computing device replies that the cursor can move no farther or a window can scroll no farther.

[0046] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0047] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and together with the description, serve to explain the principles of the invention. In the drawings:

[0048] FIG. **1** is a block diagram of the integrated manual input apparatus;

[0049] FIG. **2** is a schematic drawing of the proximity sensor with voltage amplifier;

[0050] FIGS. **3**A and **3**B are schematic drawings of the proximity sensor with an integrating current amplifier;

[0051] FIGS. **4**A and **4**B are schematic drawings of the proximity sensor implemented with field effect transistors;

[0052] FIGS. **5**A and **5**B are schematic drawings of the proximity sensor as used to implement 2D arrays of proximity sensors;

[0053] FIG. **6** is a block diagram showing a typical architecture for a 2D array of proximity sensors where all sensors share the same amplifier;

[0054] FIGS. **7**A and **7**B are block diagrams of circuitry used to convert proximity sensor output to a digital code;

[0055] FIG. **8** is a block diagram showing a typical architecture for a 2D array of proximity sensors where sensors within a row share the same amplifier;

[0056] FIGS. **9**A and **9**B are schematics of a circuit useful for enabling the output gates of all proximity sensors within a group (arranged in columns);

[0057] FIG. **10** is a side view of a 2D proximity sensor array that is sensitive to the pressure exerted by non-conducting touch objects;

[0058] FIG. **11** is a, side view of a 2D proximity sensor array that provides a compliant surface without loss of spatial sensitivity;

[0059] FIG. **12** is a side view of a 2D proximity sensor array that is sensitive to both the proximity of conducting touch objects and to the pressure exerted by non-conducting touch objects;

[0060] FIG. **13** is an example proximity image of a hand flattened onto the surface with fingers outstretched;

[0061] FIG. **14** is an example proximity image of a hand partially closed with fingertips normal to surface;

[0062] FIG. **15** is an example proximity image of a hand in the pen grip configuration with thumb and index fingers pinched;

[0063] FIG. **16** is a data flow diagram of the hand tracking and contact identification system;

[0064] FIG. **17** is a flow chart of hand position estimation:

[0065] FIG. **18** is a data flow diagram of proximity image segmentation;

[0066] FIG. **19** is a diagram of the boundary search pattern during construction of an electrode group;

[0067] FIG. **20**A is a diagram of the segmentation strictness regions with both hands in their neutral, default position on surface;

[0068] FIG. **20**B is a diagram of the segmentation strictness regions when the hands are in asymmetric positions on surface;

[0069] FIG. **20**C is a diagram of the segmentation strictness regions when the right hand crosses to the left half of the surface and the left hand is off the surface;

[0070] FIG. **21** is a flow chart of segmentation edge testing;

[0071] FIG. **22** is a flow chart of persistent path tracking;

[0072] FIG. **23** is a flow chart of the hand part identification algorithm;

[0073] FIG. **24** is a Voronoi cell diagram constructed around hand part attractor points;

[0074] FIG. **25**A is a plot of orientation weighting factor for right thumb, right inner palm, and left outer palm versus contact orientation;

[0075] FIG. **25**B is a plot of thumb size factor versus contact size;