[0101] More specifically, embodiments of the present invention provide a new type of a flat panel display digitizer supporting both the detection, using electromagnetism, of physical objects, such as a stylus, and the detection of finger touch operations using a single transparent overlay foil system.

[0102] Embodiments may be provided as a built in part of a computing system or as an add-on accessory.

[0103] The principles and operation of a digitizer according to the present invention may be better understood with reference to the drawings and accompanying descriptions.

[0104] Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

[0105] Reference is now made to **FIG. 1**, which is a simplified block diagram showing an integrated technology digitizer according to a first preferred embodiment of the present invention. Digitizer **10**, for incorporation into for example a mobile computing device, comprises a transparent sensing arrangement **12**, which combines electromagnetic and touch sensitive transparent conductors. The sensor arrangement **12** is typically located over an LCD or other kinds of computer display. Front-end ASICs **14**, preferably mounted on the frame of the sensor, process and sample signals output by the electromagnetic sensor conductors. The sampled signals are preferably forwarded to digital processing unit **16** through data bus **18** dedicated to the electromagnetic subsystem and hereafter referred to as an electromagnetic (EM) bus **18**. A resistive bus **20** transfers touch signals between the digital unit **16** and the touch sensors. In the case of touch signals, signal transfer along the bus is bi-directional, as will be explained in greater detail below.

[0106] The digital unit **16** preferably processes both electromagnetic and touch-sensitive signals. As will be explained in greater detail below, the outcome of processing is a series of positions of electromagnetically located and/or identified objects, for example one or more styluses, and the positions of one or more fingers that touch the sensor. The digital processor output is preferably forwarded to host computing device **22** via interface **24**. In a preferred embodiment the digital unit communicates with the host via a simple serial interface. Additional interfaces, such as USB, may also be used.

[0107] The host computer preferably interprets stylus position and mode as mouse inputs. Reference is now made to **FIG. 2** which is a simplified screen illustration showing a typical display **30** on a mobile computing device that uses a virtual keyboard. A virtual keyboard **32** of the kind that may typically be provided on a host screen display is shown. The virtual keyboard comprises illustrations of standard keyboard keys arranged in a standard keyboard layout. The user is able to touch the screen at a point corresponding to a key in the display, using either a finger or a pointing device such as a stylus, and the detected locations are interpreted as the corresponding keyboard inputs.

[0108] In a preferred embodiment of the present invention, touch detection is extended only to the lower part of the screen, in which the keyboard is likely to be located, whereas stylus sensing extends to the entire screen. Such an embodiment leads to a reduction in the number of parts, and thus reduced cost coupled with greater reliability. The skilled person will appreciate that other arrangements are possible, including having each sensing system restricted to only part of the screen.

[0109] In U.S. patent application Ser. No. 09/628,334 an electromagnetic based sensing device is described which is capable of detecting physical objects, such as styluses, located on top of a flat panel display. An embodiment disclosed therein comprises a system built of two transparent foils, preferably patterned with organic conductive lines, one containing a set of vertical conductors and the other a set of horizontal conductors. The physical object contains a resonance circuit, which is energized by an excitation coil that surrounds the two sets of foils. A trigger signal for energizing is preferably provided by a signal generator at preset intervals. The exact position of the physical object is determined by processing signals issued by the physical object as a result of being thus energized. The signals as issued are sensed by the grid of horizontal and vertical conductors. Sensing resolution is higher than the grid size since signal processing allows for interpolation between the surrounding sensors.

[0110] As with the above application, in a preferred embodiment of the present invention, oscillations of the electromagnetic signals, transmitted by the resonance circuit of the physical objects, may be sensed by a two dimensional matrix of conductors. The conductive lines are patterned on a transparent foil, separated by nonconductive areas between the lines. However, in embodiments of the present invention, conductive stripes (alternatively called pressure stripes) are patterned between the electromagnetic conductors on each of the foils. These conductive stripes are used for sensing the touch pressure. The conductive lines and pressure stripes are preferably made of organic conductive materials.

[0111] The conductive lines may be formed by etching from a uniform conductive layer or may be printed onto the foil. As a further alternative a layer of conductive material is provided and then, where conduction is not required, a passivation process is provided.

[0112] Reference is now made to **FIG. 3**, which is a schematic diagram showing conductors laid out on a two-layer sensing arrangement according to a preferred embodiment of the present invention. The arrangement used in **FIG. 3** is known as a resistive matrix. Arrangement **40** is preferably formed of a two-dimensional grid of transparent conductors. The arrangement preferably comprises two foil layers, a first foil layer containing a first set of parallel conductive lines **42**, and a second foil layer containing a second set of parallel conductive lines **44**. The foils are preferably arranged so that the second set of parallel conductive lines are substantially orthogonal to the first set.

[0113] In a preferred embodiment, touch sensitive wide conductive stripes **46** are patterned between EM sensitive narrow conductive lines **48** in each of the first and second