

## CLAIMS

~~What is claimed is:~~

1. A method for distinguishing between sources of simultaneous touch events on a touch sensitive device, the touch sensitive device comprising a plurality of row conductors and a plurality of column conductors, the path of each of the row conductors crossing the path of each of the column conductors, the method comprising:

simultaneously transmitting each of a plurality of orthogonal row signals on a respective one of at least some of the plurality of row conductors;

detecting an amount of each of the plurality of orthogonal row signals present on each of the plurality of column conductors;

simultaneously transmitting each of a plurality of orthogonal column signals on a respective one of at least some of the column conductors;

detecting an amount of each of the plurality of orthogonal column signals present on each of the plurality of row conductors;

detecting an amount of at least one of the plurality of orthogonal row signals present on at least one row conductor;

detecting an amount of ~~each~~ at least one of the plurality of orthogonal column signals present on at least one column conductor; and,

associating each of the plurality of simultaneous touch events with a discrete source based on at least one of: the detected amount of at least one of the plurality of orthogonal row signals present on at least one row conductor or the detected amount of ~~each~~ at least one of the plurality of orthogonal column signals present on at least one column conductor.

- ~~2. The method of claim 1, further comprising a step of distinguishing a two-handed gesture from a one-handed gesture.~~
- ~~3. The method of claim 1, further comprising a step of distinguishing at least two of the plurality of touch events as having been initiated by different users.~~

- ~~4. The method of claim 1, further comprising a step of distinguishing a passive object from a hand.~~
- ~~5. The method of claim 1, further comprising a step of identifying a passive object whether a user is touching the object or not.~~
- ~~6. The method of claim 1, further comprising a step of identifying a passive object.~~
- ~~7. The method of claim 6, wherein the passive object is a stylus.~~
- ~~8. The method of claim 6, wherein the step of identifying a passive object comprises identifying a number of prongs that are connected together and form a specific pattern.~~
- ~~9. The method of claim 6, wherein the step of identifying a passive object comprises switching to electrical connections between the touches in a pattern that is recognizable to the touch sensitive device.~~
- ~~10. The method of claim 1, further comprising a step of identifying an active object.~~
- ~~11. The method of claim 10, wherein the active object comprises a signal generator.~~
- ~~12. The method of claim 10, wherein the active object is a stylus.~~
- ~~13. The method of claim 1, further comprising using the association to improve palm rejection.~~
- ~~14. The method of claim 1, further comprising using the association to improve accidental touch rejection.~~
- ~~15. The method of claim 1, further comprising a step of determining whether the plurality of touch events come from one hand.~~
- ~~16. The method of claim 1, further comprising a step of determining whether the plurality of touch events come from two hands of the same person.~~
- ~~17. The method of claim 1, further comprising a step of determining whether the plurality of touch events come from touches from multiple people.~~
- ~~18. The method of claim 1, further comprising a step of determining whether two contacts, each identified in different frames, are being made by different users.~~

- ~~19. The method of claim 1, further comprising a step of determining whether two contacts, each identified in different frames, are the same contact.~~
- ~~20. The method of claim 1, further comprising a step of utilizing multiple thresholds.~~
- ~~21. The method of claim 20, further comprising using the multiple thresholds to determine at least one of: whether two of the plurality of touch events come from one hand, whether two of the plurality of touch events come from two hands of the same person, or whether two of the plurality of touch events come from the hands of different people.~~
- ~~22. The method of claim 20, wherein the thresholds are set adaptively as the touch sensitive device is being used.~~
- ~~23. The method of claim 1, wherein the step of identifying touch events is performed by a signal processor.~~
- ~~24. The method of claim 1, wherein the step of identifying touch events comprises detecting coupling between a row being touched by a first one of a user's digits and a row being touched by a second one of the user's digits.~~
- ~~25. The method of claim 1, wherein the step of identifying touch events comprises detecting coupling between a column being touched by a first one of a user's digits and a column being touched by a second one of the user's digits.~~
- 26.2. The method of claim 1, wherein the step of identifying touch events comprises detecting coupling between rows in proximity to a touch event caused by one part of a user's body and rows in proximity to a touch event caused by another part of a user's body.
- ~~27. The method of claim 26, wherein the one part of a user's body is a digit and the another part of the user's body comprises the user's palm.~~
- ~~28. The method of claim 1, wherein the touch events comprise an action by a user that occurs in proximity to the touch sensitive device.~~
- ~~29. The method of claim 1, wherein:~~
- ~~the step of simultaneously transmitting each of a plurality of orthogonal row signals comprises transmitting orthogonal signals on each row of the touch sensitive device;~~

~~the step of simultaneously transmitting each of a plurality of orthogonal column signals comprises transmitting orthogonal column signals on each column of the touch sensitive device;~~

~~the step of detecting an amount of each of the plurality of orthogonal row signals present on each of the plurality of column conductors comprises detecting orthogonal row signals on each column of the touch sensitive device; and,~~

~~the step of detecting an amount of each of the plurality of orthogonal column signals present on each of the plurality of row conductors comprises detecting orthogonal column signals on each row of the device.~~

~~30. The method of claim 1, further comprising a step of applying a label to a contact.~~

~~31. The method of claim 30, further comprising:~~

~~causing the label applied to the contact to persist across frames.~~

~~32. The method of claim 1, wherein the row conductors and column conductors are arranged in a grid.~~

~~33. The method of claim 1, wherein the row conductors and column conductors are arranged in a shape other than a grid.~~

~~34. The method of claim 33, wherein the row conductors are arranged in concentric circles.~~

~~35. The method of claim 34, wherein the column conductors are arranged as spokes radiating out from a center of said concentric circles.~~

~~36. The method of claim 1, further comprising a third type of conductors in addition to row conductors and column conductors.~~

~~37.3.~~ A method for distinguishing between sources of simultaneous touch events on a touch sensitive device, the touch sensitive device comprising a plurality of row conductors and a plurality of column conductors, the path of each of the row conductors crossing the path of each of the column conductors, the method comprising:

simultaneously transmitting each of a plurality of orthogonal row signals on a respective one of at least some of the plurality of row conductors;

detecting an amount of at least one of the plurality of orthogonal row signals present on at least one of the plurality of row conductors;

simultaneously transmitting each of a plurality of orthogonal column signals on a respective one of at least some of the plurality of column conductors;

~~detecting an amount of each of the plurality of orthogonal column signals present on at least one of the column conductors;~~

identifying the touch events on the touch sensitive device ~~using the detected amount of each of the plurality of orthogonal row signals~~; and

associating each of the plurality of simultaneous touch events with a discrete source based at least in part on ~~a the~~ detected amount of at least one of the plurality of orthogonal row signals present on at least one of the plurality of row conductors.

~~38. The method of claim 37, further comprising a step of distinguishing a two-handed gesture from a one-handed gesture.~~

~~39. The method of claim 37, further comprising a step of distinguishing at least two of the plurality of touch events as having been initiated by different users.~~

~~40. The method of claim 37, further comprising a step of distinguishing a passive object from a hand.~~

~~41. The method of claim 37, further comprising a step of identifying a passive object whether a user is touching the object or not.~~

~~42. The method of claim 37, further comprising a step of identifying a passive object.~~

~~43. The method of claim 42, wherein the passive object is a stylus.~~

~~44. The method of claim 41, wherein the step of identifying a passive object comprises identifying a number of prongs that are connected together and form a specific pattern.~~

~~45. The method of claim 41, wherein the step of identifying a passive object comprises switching to electrical connections between the touches in a pattern that is recognizable to the touch sensitive device.~~

- ~~46. The method of claim 37, further comprising a step of identifying an active object.~~
- ~~47. The method of claim 46, wherein the active object comprises a signal generator.~~
- ~~48. The method of claim 46, wherein the active object is a stylus.~~
- ~~49. The method of claim 37, further comprising using the association to improve palm rejection.~~
- ~~50. The method of claim 37, further comprising using the association to improve accidental touch rejection.~~
- ~~51. The method of claim 37, further comprising a step of determining whether the plurality of touch events come from one hand.~~
- ~~52. The method of claim 37, further comprising a step of determining whether the plurality of touch events come from two hands of the same person.~~
- ~~53. The method of claim 37, further comprising a step of determining whether the plurality of touch events come from touches from multiple people.~~
- ~~54. The method of claim 37, further comprising a step of determining whether two contacts, each identified in different frames, are being made by different users.~~
- ~~55. The method of claim 37, further comprising a step of determining whether two contacts, each identified in different frames, are the same contact.~~
- ~~56. The method of claim 37, further comprising a step of utilizing multiple thresholds.~~
- ~~57. The method of claim 56, further comprising using the multiple thresholds to determine at least one of: whether two of the plurality of touch events come from one hand, whether two of the plurality of touch events come from two hands of the same person, or whether two of the plurality of touch events come from the hands of different people.~~
- ~~58. The method of claim 56, wherein the thresholds are set adaptively as the touch sensitive device is being used.~~
- ~~59. The method of claim 37, wherein the step of identifying touch events is performed by a signal processor.~~

~~60. The method of claim 37, wherein the step of identifying touch events comprises detecting coupling between a row being touched by a first one of a user's digits and a row being touched by a second one of the user's digits.~~

~~61.4. \_\_\_\_\_~~ The method of claim ~~37~~3, further comprising:

detecting an amount of each of the plurality of orthogonal column signals present on at least one of the plurality of row conductors;

detecting an amount of each of the plurality of orthogonal row signals present on at least one of the plurality of column conductors;

detecting an amount of each of the plurality of orthogonal column signals present on at least one of the plurality of column conductors;

wherein the step of identifying touch events ~~comprises detecting coupling between a column being touched by a first one of a user's digits and a column being touched by a second one of the user's digits~~ is based on the detected amount of each of the plurality of orthogonal column signals present on at least one of the plurality of row conductors and the detected amount of each of the plurality of orthogonal row signals present on at least one of the plurality of column conductors; and

wherein the step of associated is also based, at least in part, on the detected amount of each of the plurality of orthogonal column signals present on at least one of the plurality of column conductors.

~~62. The method of claim 37, wherein the step of identifying touch events comprises detecting coupling between rows in proximity to a touch event caused by one part of a user's body and rows in proximity to a touch event caused by another part of a user's body.~~

~~63. The method of claim 62, wherein the one part of a user's body is a digit and the another part of the user's body comprises the user's palm.~~

~~64. The method of claim 37, wherein the touch events comprise an action by a user that occurs in proximity to the touch sensitive device.~~

~~65.5. \_\_\_\_\_~~ The method of either claim ~~37~~1 or 3, wherein:

the step of simultaneously transmitting each of a plurality of orthogonal row signals comprises transmitting orthogonal signals on each row of the touch sensitive device;

the step of simultaneously transmitting each of a plurality of orthogonal column signals comprises transmitting orthogonal column signals on each column of the touch sensitive device; and

the step of detecting an amount of each-at least one of the plurality of orthogonal row signals present on each-at least one of the plurality of ~~column-row~~ conductors comprises detecting orthogonal row signals on each ~~column-row~~ of the touch sensitive device; ~~and,~~

~~the step of detecting an amount of each of the plurality of orthogonal column signals present on each of the plurality of row conductors comprises detecting orthogonal column signals on each row of the device.~~

~~66. The method of claim 37, further comprising a step of applying a label to a contact.~~

~~67. The method of claim 66, further comprising:~~

~~causing the label applied to the contact to persist across frames.~~

~~68. The method of claim 37, wherein the row conductors and column conductors are arranged in a grid.~~

~~69. The method of claim 37, wherein the row conductors and column conductors are arranged in a shape other than a grid.~~

~~70. The method of claim 69, wherein the row conductors are arranged in concentric circles.~~

~~71. The method of claim 70, wherein the column conductors are arranged as spokes radiating out from a center of said concentric circles.~~

~~72. The method of claim 37, further comprising a third type of conductors in addition to row conductors and column conductors.~~

~~73.6.~~ 6. A method for distinguishing between sources of a plurality of simultaneous touch events on a touch sensitive device, the touch sensitive device comprising a plurality of

row conductors and a plurality of column conductors, the path of each of the row conductors crossing the path of each of the column conductors, the method comprising:

detecting an amount of each of a plurality of orthogonal row signals present on each of the plurality of row conductors; and,

associating each of the plurality of simultaneous touch events with a discrete source based on a detected amount of at least one of the plurality of orthogonal row signals present on at least one of the plurality of row conductors.

~~74.7.~~ 74.7. The method of any one of claims 731, 3 and 6, further comprising a step of distinguishing (i) a two-handed gesture from a one-handed gesture, (ii) at least two of the plurality of touch events as having been initiated by different users, and/or (iii) a passive object from a hand.

~~75. The method of claim 73, further comprising a step of distinguishing at least two of the plurality of touch events as having been initiated by different users.~~

~~76. The method of claim 73, further comprising a step of distinguishing a passive object from a hand.~~

~~77.8.~~ 77.8. The method of any one of claims 731, 3 and 6, further comprising a step of identifying a stylus or other passive object whether a user is touching the object or not.

~~78. The method of claim 73, further comprising a step of identifying a passive object.~~

~~79. The method of claim 78, wherein the passive object is a stylus.~~

~~80. The method of claim 78, wherein the step of identifying a passive object comprises identifying a number of prongs that are connected together and form a specific pattern.~~

~~81. The method of claim 78, wherein the step of identifying a passive object comprises switching to electrical connections between the touches in a pattern that is recognizable to the touch sensitive device.~~

~~82.9.~~ 82.9. The method of any one of claims 731, 3 and 6, further comprising a step of identifying ~~an~~ signal generator, a stylus or other active object.

~~83. The method of claim 82, wherein the active object comprises a signal generator.~~

~~84. The method of claim 82, wherein the active object is a stylus.~~

~~85.10. The method of any one of claims 731, 3 and 6, further comprising using the association to improve palm rejection or accidental-touch rejection.~~

~~86. The method of claim 73, further comprising using the association to improve accidental-touch rejection.~~

~~87.11. The method of any one of claims 731, 3 and 6, further comprising a step of determining whether the plurality of touch events come from one hand.~~

~~88.12. The method of any one of claims 731, 3 and 6, further comprising a step of:~~

~~i) determining whether the plurality of touch events come from two hands of the same person;~~

~~ii) determining whether the plurality of touch events come from touches from multiple people;~~

~~iii) determining whether two contacts, each identified in different frames, are being made by different users;~~

~~iv) determining whether two contacts, each identified in different frames, are the same contact; and/or~~

~~v) utilizing multiple thresholds.~~

~~89. The method of claim 73, further comprising a step of determining whether the plurality of touch events come from touches from multiple people.~~

~~90. The method of claim 73, further comprising a step of determining whether two contacts, each identified in different frames, are being made by different users.~~

~~91. The method of claim 73, further comprising a step of determining whether two contacts, each identified in different frames, are the same contact.~~

~~92. The method of claim 73, further comprising a step of utilizing multiple thresholds.~~

~~93. The method of claim 92, further comprising using the multiple thresholds to determine at least one of: whether two of the plurality of touch events come from one hand, whether~~

~~two of the plurality of touch events come from two hands of the same person, or whether two of the plurality of touch events come from the hands of different people.~~

~~94. The method of claim 92, wherein the thresholds are set adaptively as the touch-sensitive device is being used.~~

~~95.13. The method of any one of claims 731, 3 and 6, further comprising identifying touch events, wherein the step of identifying touch events~~associating~~ is performed by a signal processor.~~

~~96.14. The method of any one of claims 731, 3 and 6, wherein the step of identifying touch events~~associating~~ comprises:~~

~~i) detecting coupling between a row being touched by a first one of a user's digits and a row being touched by a second one of the user's digits;~~

~~ii) detecting coupling between a column being touched by a first one of a user's digits and a column being touched by a second one of the user's digits; and/or~~

~~iii) detecting coupling between rows in proximity to a touch event caused by one part of a user's body and rows in proximity to a touch event caused by another part of a user's body.~~

~~97. The method of claim 73, wherein the step of identifying touch events comprises detecting coupling between a column being touched by a first one of a user's digits and a column being touched by a second one of the user's digits.~~

~~98. The method of claim 73, wherein the step of identifying touch events comprises detecting coupling between rows in proximity to a touch event caused by one part of a user's body and rows in proximity to a touch event caused by another part of a user's body.~~

~~99. The method of claim 98, wherein the one part of a user's body is a digit and the another part of the user's body comprises the user's palm.~~

~~100.15. The method of any one of claims 731, 3 and 6, wherein the touch events comprise an action by a user that occurs in proximity to the touch sensitive device.~~

~~101.16. The method of any one of claims 731, 3 and 6, further comprising a step of applying a label to a contact.~~

~~102. The method of claim 101, further comprising:~~

~~causing the label applied to the contact to persist across frames.~~

~~103. The method of claim 73, wherein the row conductors and column conductors are arranged in a grid.~~

~~104.17.~~ The method of any one of claims 731, 3 and 6, wherein the row conductors and column conductors are arranged in a shape other than a grid.

~~105. The method of claim 104, wherein the row conductors are arranged in concentric circles.~~

~~106. The method of claim 105, wherein the column conductors are arranged as spokes radiating out from a center of said concentric circles.~~

~~107.18.~~ The method of any one of claims 731, 3 and 6, further comprising a third type of conductors in addition to row conductors and column conductors.

~~108.19.~~ A low-latency touch sensitive device comprising:

a. a plurality of row conductors and column conductors arranged such that:

- i. each of the paths of the conductors of the plurality of row conductors cross each of the paths of the conductors of the plurality of column conductors, and wherein
- ii. when the touch sensitive device is not being touched, a first level of signal is coupled between them, and
- iii. when the touch sensitive device is being touched, a second level of signal is coupled between them;

b. row signal generator operatively connected to the plurality of row conductors, the row signal generator adapted to simultaneously generate a plurality of unique orthogonal row signals, each unique orthogonal row signal being orthogonal to each of the other unique orthogonal row signals;

c. column signal decoder operatively connected to the plurality of column conductors, the column signal decoder adapted to detect a level for each of the

plurality of unique orthogonal row signals on each of the plurality of column conductors;

- d. column signal generator operatively connected to the plurality of column conductors, the column signal generator adapted to simultaneously generate a plurality of unique orthogonal column signals, each unique orthogonal column signal being orthogonal to each of the other unique orthogonal column signals;
- e. row signal decoder operatively connected to the plurality of row conductors, the row signal decoder adapted to detect a level for each of the plurality of unique orthogonal column signals on each of the plurality of row conductors and a level for each of the plurality of unique orthogonal row signals on each of the plurality of row conductors; and
- f. processor configured to associate each of a plurality of simultaneous touch events with a discrete source based on a detected amount of at least one of the plurality of orthogonal row signals present on at least one of the plurality of row conductors.

109.20 The device of claim 10819, wherein the processor is further configured to distinguish a two-handed gesture from a one-handed gesture.

110.21 The device of claim 10819, wherein the processor is further configured to distinguish at least two of the plurality of touch events as having been initiated by different users.

111.22. The device of claim 10819, wherein the processor is further configured to distinguish a passive object from a hand.

112.23. The device of claim 10819, wherein the processor is further configured to identify a passive object whether a user is touching the object or not.

113.24. The device of claim 10819, wherein the processor is further configured to identify a stylus or other passive object.

~~114. The device of claim 113, wherein the passive object is a stylus.~~

~~115. The device of claim 113, wherein the processor is further configured to identify a number of prongs that are connected together and form a specific pattern.~~

~~116. The device of claim 113, wherein the processor is further configured to switch to electrical connections between the touches in a pattern that is recognizable to the touch sensitive device.~~

~~117.25.~~ The device of claim ~~108~~19, wherein the processor is further configured to identify ~~an~~ signal generator, a stylus or other active object.

~~118. The device of claim 117, wherein the active object comprises a signal generator.~~

~~119. The device of claim 117, wherein the active object is a stylus.~~

~~120.26.~~ The device of claim ~~108~~19, wherein the processor is further configured to use the association to improve palm rejection and/or accidental-touch rejection.

~~121. The device of claim 108, wherein the processor is further configured to use the association to improve accidental-touch rejection.~~

~~122.27.~~ The device of claim ~~108~~19, wherein the processor is further configured

i) to determine whether the plurality of touch events come from one hand;

ii) to determine whether the plurality of touch events come from two hands of the same person;

iii) to determine whether the plurality of touch events come from touches from multiple people;

iv) to determine whether two contacts, each identified in different frames, are being made by different users;

v) to determine whether two contacts, each identified in different frames, are the same contact; and/or

vi) to utilize multiple thresholds.

~~123. The device of claim 108, wherein the processor is further configured to determine whether the plurality of touch events come from two hands of the same person.~~

~~124. The device of claim 108, wherein the processor is further configured to determine whether the plurality of touch events come from touches from multiple people.~~

~~125. The device of claim 108, wherein the processor is further configured to determine whether two contacts, each identified in different frames, are being made by different users.~~

~~126. The device of claim 108, wherein the processor is further configured to determine whether two contacts, each identified in different frames, are the same contact.~~

~~127. The device of claim 108, wherein the processor is further configured to utilize multiple thresholds.~~

~~128. The device of claim 127, wherein the processor is further configured to use the multiple thresholds to determine at least one of: whether two of the plurality of touch events come from one hand, whether two of the plurality of touch events come from two hands of the same person, or whether two of the plurality of touch events come from the hands of different people.~~

~~129. The device of claim 127, wherein the processor is further configured to set the thresholds adaptively as the touch-sensitive device is being used.~~

~~130.28.~~ The device of claim ~~108~~19, wherein processor is a signal processor.

~~131.29.~~ The device of claim ~~108~~19, wherein the processor is further configured

i) to detect coupling between a row being touched by a first one of a user's digits and a row being touched by a second one of the user's digits;

ii) to detect coupling between a column being touched by a first one of a user's digits and a column being touched by a second one of the user's digits; and/or

iii) to detect coupling between rows in proximity to a touch event caused by one part of a user's body and rows in proximity to a touch event caused by another part of a user's body.

~~132. The device of claim 108, wherein the processor is further configured to detect coupling between a column being touched by a first one of a user's digits and a column being touched by a second one of the user's digits.~~

~~133. The device of claim 108, wherein the processor is further configured to detect coupling between rows in proximity to a touch event caused by one part of a user's body and rows in proximity to a touch event caused by another part of a user's body.~~

~~134. — The device of claim 133, wherein the one part of a user's body is a digit and the another part of the user's body comprises the user's palm.~~

~~135.30.~~ The device of claim ~~108~~19, wherein the touch events comprise an action by a user that occurs in proximity to the touch sensitive device.

~~136.31.~~ The device of claim ~~108~~19, wherein the processor is further configured to apply a label to a contact.

~~137. — The device of claim 136, wherein the processor is further configured to cause the label applied to the contact to persist across frames.~~

~~138. — The device of claim 108, wherein the row conductors and column conductors are arranged in a grid.~~

~~139.32.~~ The device of claim ~~108~~19, wherein the row conductors and column conductors are arranged in a shape other than a grid.

~~140. — The device of claim 139, wherein the row conductors are arranged in concentric circles.~~

~~141. — The device of claim 140, wherein the column conductors are arranged as spokes radiating out from a center of said concentric circles.~~

~~142.33.~~ The device of claim ~~108~~19, further comprising a third type of conductors in addition to row conductors and column conductors.