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(54) METHOD AND APPARATUS FOR INTEGRATING MANUAL INPUT

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(57) **ABSTRACT**

Apparatus and methods are disclosed for simultaneously tracking multiple finger and palm contacts as hands approach, touch, and slide across a proximity-sensing. compliant, and flexible multi-touch surface. The surface consists of compressible cushion, dielectric, electrode, and circuitry layers. A simple proximity transduction circuit is placed under each electrode to maximize signal-to-noise ratio and to reduce wiring complexity. Such distributed transduction circuitry is economical for large surfaces when implemented with thin-film transistor techniques. Scanning and signal offset removal on an electrode array produces low-noise proximity images. Segmentation processing of each proximity image constructs a group of electrodes corresponding to each distinguishable contact and extracts shape, position and surface proximity features for each group. Groups in successive images which correspond to the same hand contact are linked by a persistent path tracker which also detects individual contact touchdown and liftoff. Combinatorial optimization modules associate each contact's path with a particular fingertip, thumb, or palm of either hand on the basis of biomechanical constraints and contact features. Classification of intuitive hand configurations and motions enables unprecedented integration of typing, resting, pointing, scrolling, 3D manipulation, and handwriting into a versatile, ergonomic computer input device.