

after receiving a match point in the sequence of match points on the graphical interface. In another embodiment, the training logic element causes the graphical interface to display a line from the match point to the selected point associated with the image on the graphical interface.

[0034] In one embodiment, the apparatus includes a memory element in signal communication with the offset calculator. The memory element stores the sequence of offsets from the offset calculator for use in authenticating a user. In another embodiment, the memory element is in signal communication with the hasher. The memory element stores the hash of the sequence of codewords from the hasher for use in authenticating a user. In one embodiment, the apparatus includes a memory element in signal communication with the codeword generator. The memory element stores the sequence of codewords from the codeword generator for use in authenticating a user.

[0035] In general, in another aspect, the invention relates to an apparatus for authenticating a user. The apparatus includes a graphical interface capable of receiving graphical input. The graphical interface receives an input pattern as graphical input. The input pattern includes a sequence of discrete graphical choices. The apparatus includes a converter in signal communication with the graphical interface. The converter converts each discrete graphical choice in the sequence of discrete graphical choices into an input value to produce a sequence of input values. The sequence of input values corresponds to the sequence of discrete graphical choices. The apparatus, in some embodiments, includes a memory element in signal communication with a summer. The memory element contains a sequence of offsets. In embodiments that include a summer, the summer is in signal communication with the converter and the memory element. The summer sums each input value from the sequence of input values with the corresponding offset from the sequence of offsets to generate a sequence of intermediate values. The apparatus includes a codeword generator in signal communication with the summer in embodiments that contain a summer, and with the converter in other embodiments. The codeword generator produces a sequence of codewords by applying a decoding function of an error correcting code. In embodiments that include a summer, the decoding function is applied to each intermediate value in the sequence of intermediate values. In embodiments that do not include a summer, the decoding function is applied to each input value from the sequence of input values. The apparatus, in some embodiments, includes a hasher in signal communication with the codeword generator. The hasher applies a hash function to the sequence of codewords to produce a hash of the sequence of codewords for use in authenticating a user.

[0036] In one embodiment, the apparatus includes a comparator in signal communication with the hasher. The comparator, in the embodiment, compares the hash of the sequence of codewords to a stored hash and produces an authentication signal if the hash of the sequence of codewords matches the stored hash. In one embodiment, the authentication signal enables access to a resource. In one embodiment, the authentication signal enables access to at least one of a hardware device, a computer system, a portable computer, a software application, a database, and a physical location.

[0037] In one embodiment, the apparatus includes a communication system in signal communication with the hasher.

The communication system transmits the hash of the sequence of codewords to an authentication device and receives an authentication signal from the authentication device if the hash of the sequence of codewords matches the stored hash.

[0038] In one embodiment, a discrete graphical choice in the sequence of discrete graphical choices includes a selected region on the graphical interface. In one embodiment, a discrete graphical choice in the sequence of discrete graphical choices includes a selected point on the graphical interface. In one embodiment, a logic element in signal communication with the graphical interface causes the graphical interface to display a new image in response to the graphical interface receiving a discrete graphical choice from the sequence of discrete graphical choices. The sequence of discrete graphical choices in such embodiments corresponds to a sequence of images.

[0039] In one embodiment, the apparatus includes a comparator in signal communication with the codeword generator. The comparator, in such embodiments, compares the sequence of codewords to a stored sequence of codewords and produces an authentication signal if the generated sequence of codewords matches the stored sequence. In one embodiment, the authentication signal enables access to a resource. In one embodiment, the authentication signal enables access to at least one of a hardware device, a computer system, a portable computer, a software application, a database, and a physical location.

[0040] In another embodiment, the apparatus also includes a logic element in signal communication with the graphical interface. The logic element causes the graphical interface to display at least one memory cue in response to a point or region on the graphical interface being highlighted. In one embodiment, the logic element causes a first icon from a plurality of icons to be displayed on the graphical interface in response to a first point on the image on the graphical interface being highlighted. The logic element causes a second icon from the plurality of icons to be displayed on the graphical interface in response to a second point on the image on the graphical interface being highlighted. In one embodiment, a discrete graphical choice in the sequence of discrete graphical choices includes a selected icon from a plurality of icons displayed on the graphical interface.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0041] The invention is pointed out with particularity in the appended claims. The above and further advantages of this invention may be better understood by referring to the following description taken in conjunction with the accompanying drawings, in which:

[0042] **FIG. 1** is a block diagram showing an enrollment system that is one aspect of the invention.

[0043] **FIG. 2** illustrates a flowchart of an enrollment process in accordance with one embodiment of the invention.

[0044] **FIG. 3** illustrates an exemplary display on a graphical interface and secret pattern of discrete graphical choices in accordance with one embodiment of the invention.

[0045] **FIG. 4** illustrates an exemplary display on a graphical interface and secret pattern of discrete graphical choices in accordance with one embodiment of the invention.