Altpass LLC v. Apple Inc Doc. 1 Att. 1

EXHIBIT A

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(12) **United States Patent**
Odom

(10) **Patent No.: US 7,350,078 B1**
(45) **Date of Patent: Mar. 25, 2008**

(54) **USER SELECTION OF COMPUTER LOGIN**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 134 days.

(21) Appl. No.: **10/090,520**

(22) Filed: **Mar. 4, 2002**

Related U.S. Application Data

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(51) **Int. Cl.**
H04L 9/00 (2006.01)

(52) **U.S. Cl.** **713/176**; 726/2

(58) **Field of Classification Search** 713/176, 713/183, 184
See application file for complete search history.

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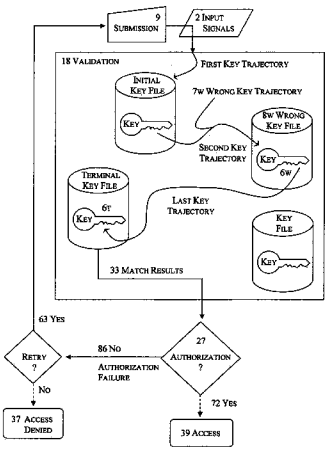
Primary Examiner—Nasser Moazzami
Assistant Examiner—David Garcia Cervetti

(57) **ABSTRACT**

Computer login may comprise any user-determined submission. A user may select the input devices used, and which types of signals from input devices are to be used for login authentication. Account identification may be inferred by signature rather than explicitly stated. A plurality of discontiguous data blocks in a plurality of files may be employed for validation. The paths to data used in validation may be multifarious, regardless of the prospects for successful authorization.

23 Claims, 10 Drawing Sheets



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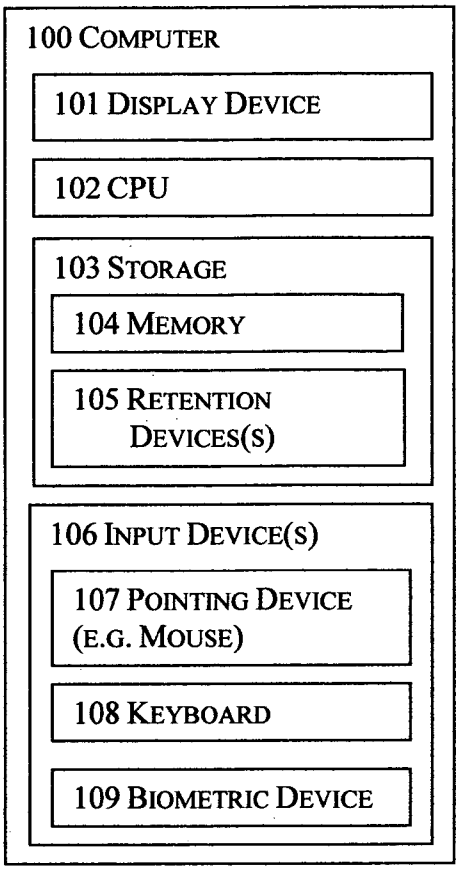

FIGURE 1

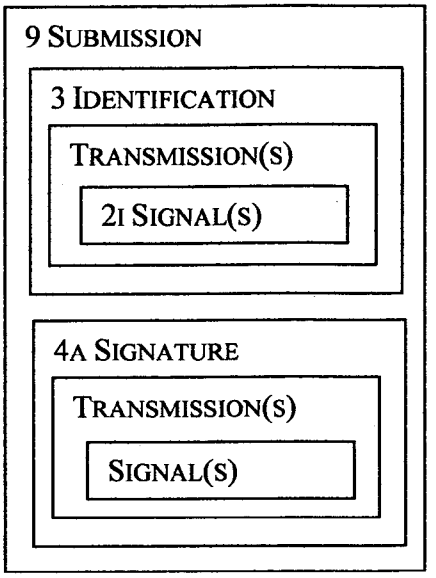

FIGURE 3

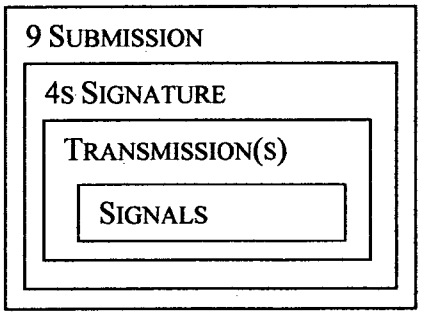

FIGURE 4

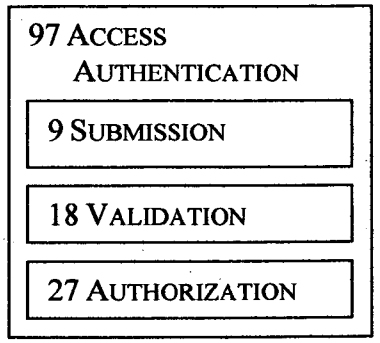

FIGURE 2

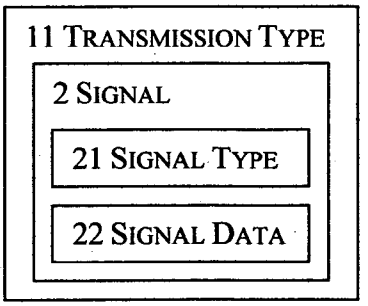

FIGURE 5

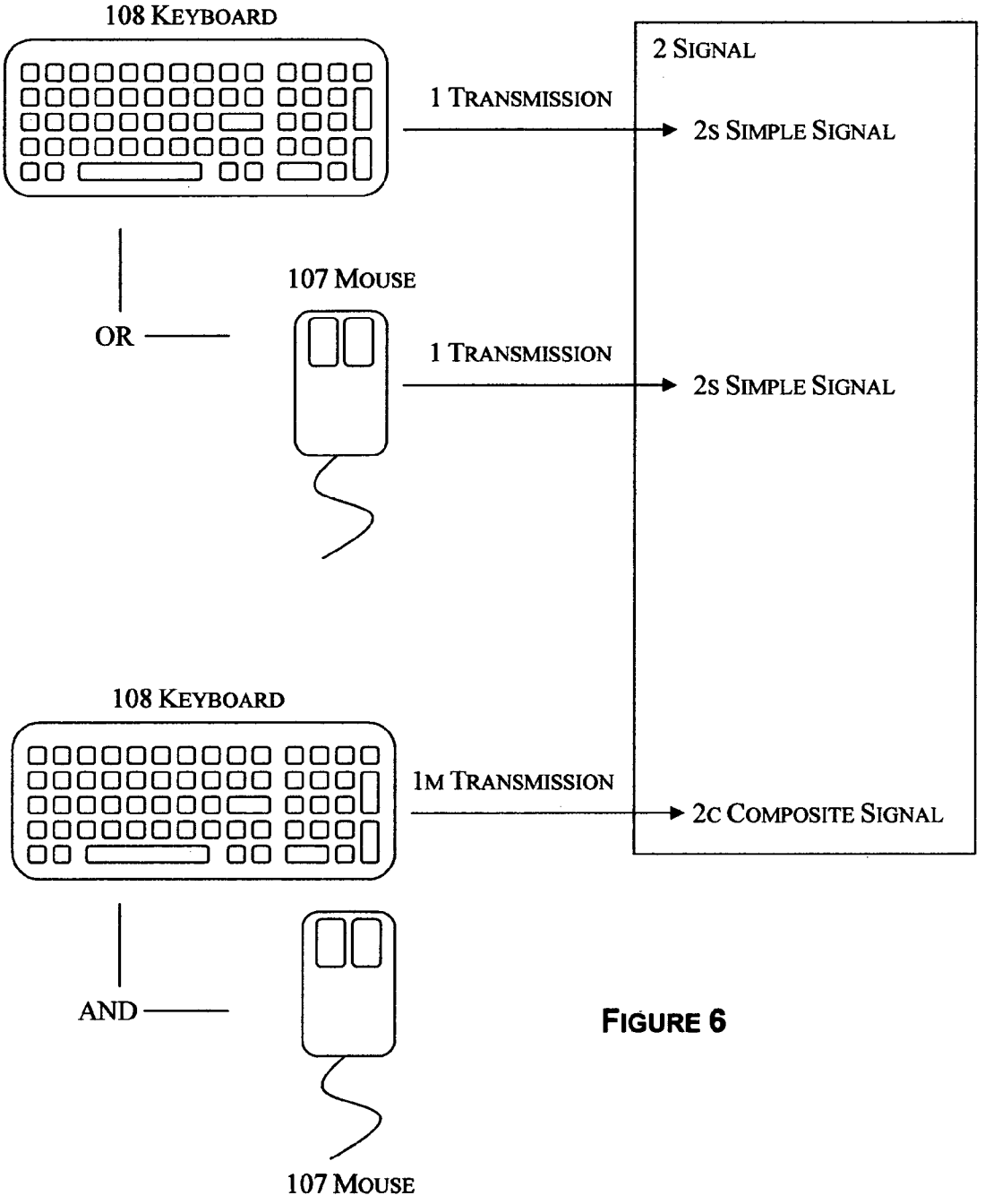
108 KEYBOARD
2 SIGNAL
1 TRANSMISSION
2S SIMPLE SIGNAL
107 MOUSE
OR
1 TRANSMISSION
2S SIMPLE SIGNAL
108 KEYBOARD
1M TRANSMISSION
2C COMPOSITE SIGNAL
AND
107 MOUSE

FIGURE 6

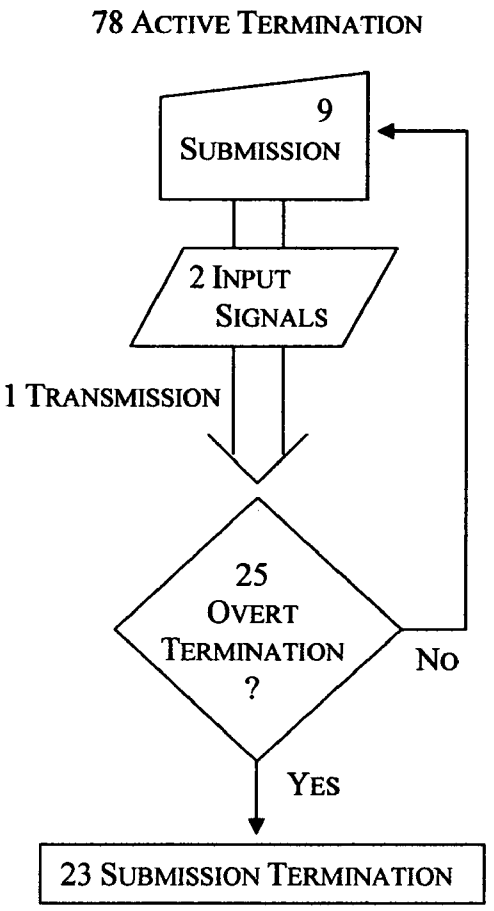

FIGURE 7

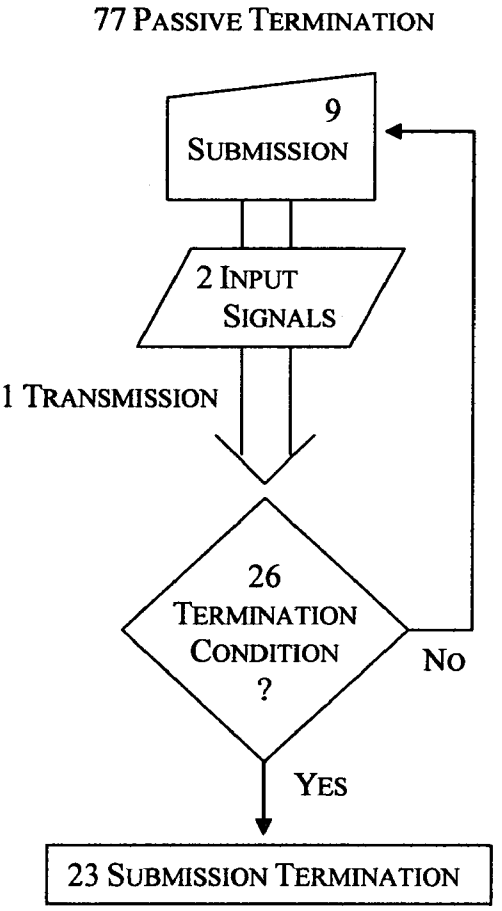

FIGURE 8

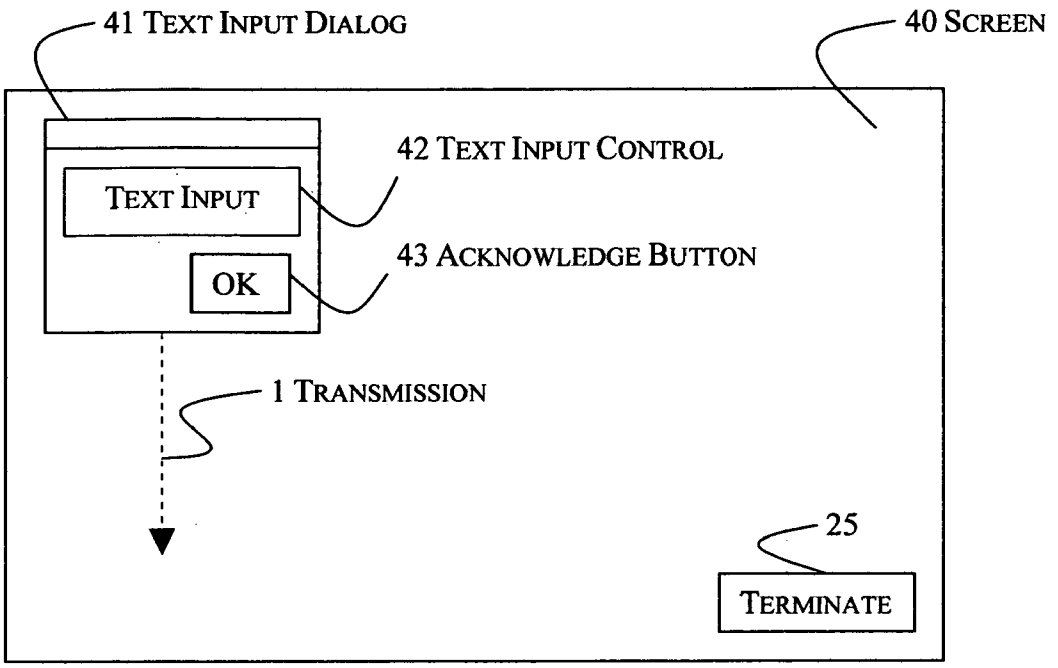

FIGURE 9

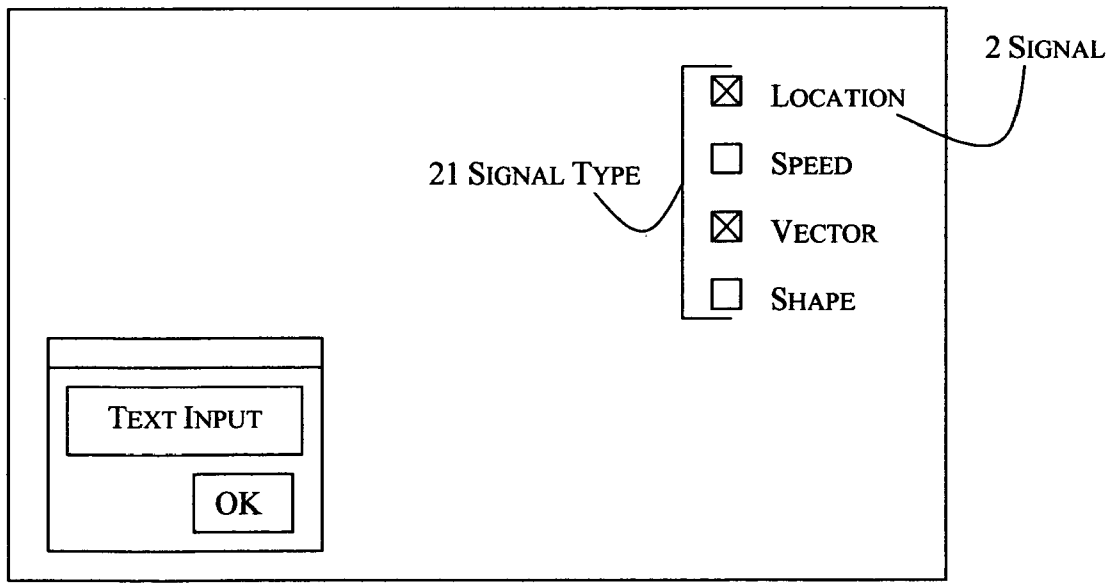

FIGURE 10

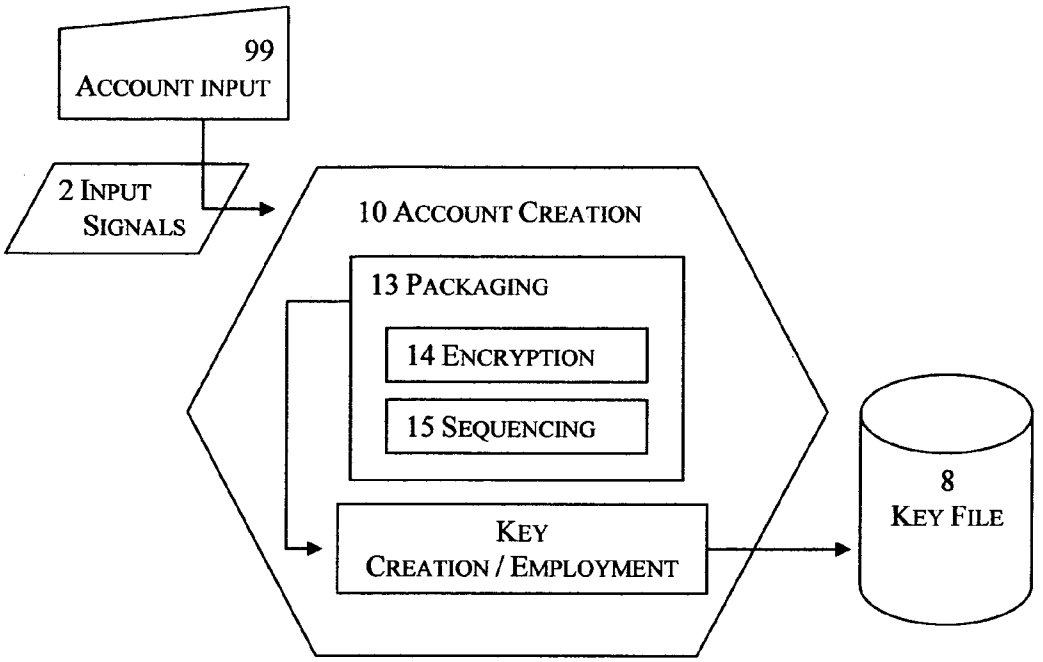

FIGURE 11

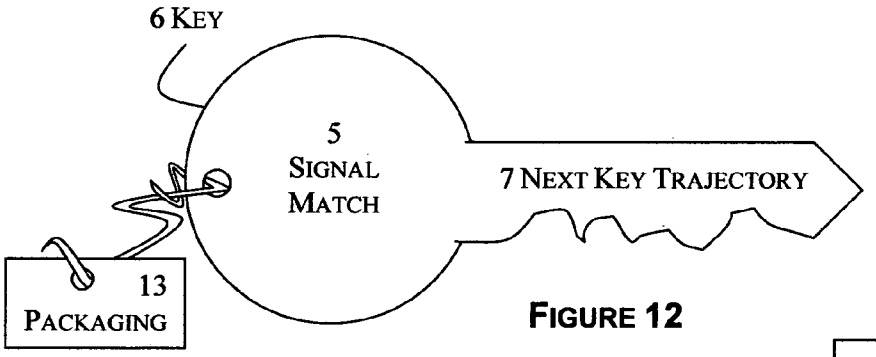

FIGURE 12

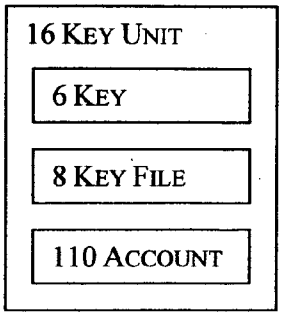

FIGURE 13

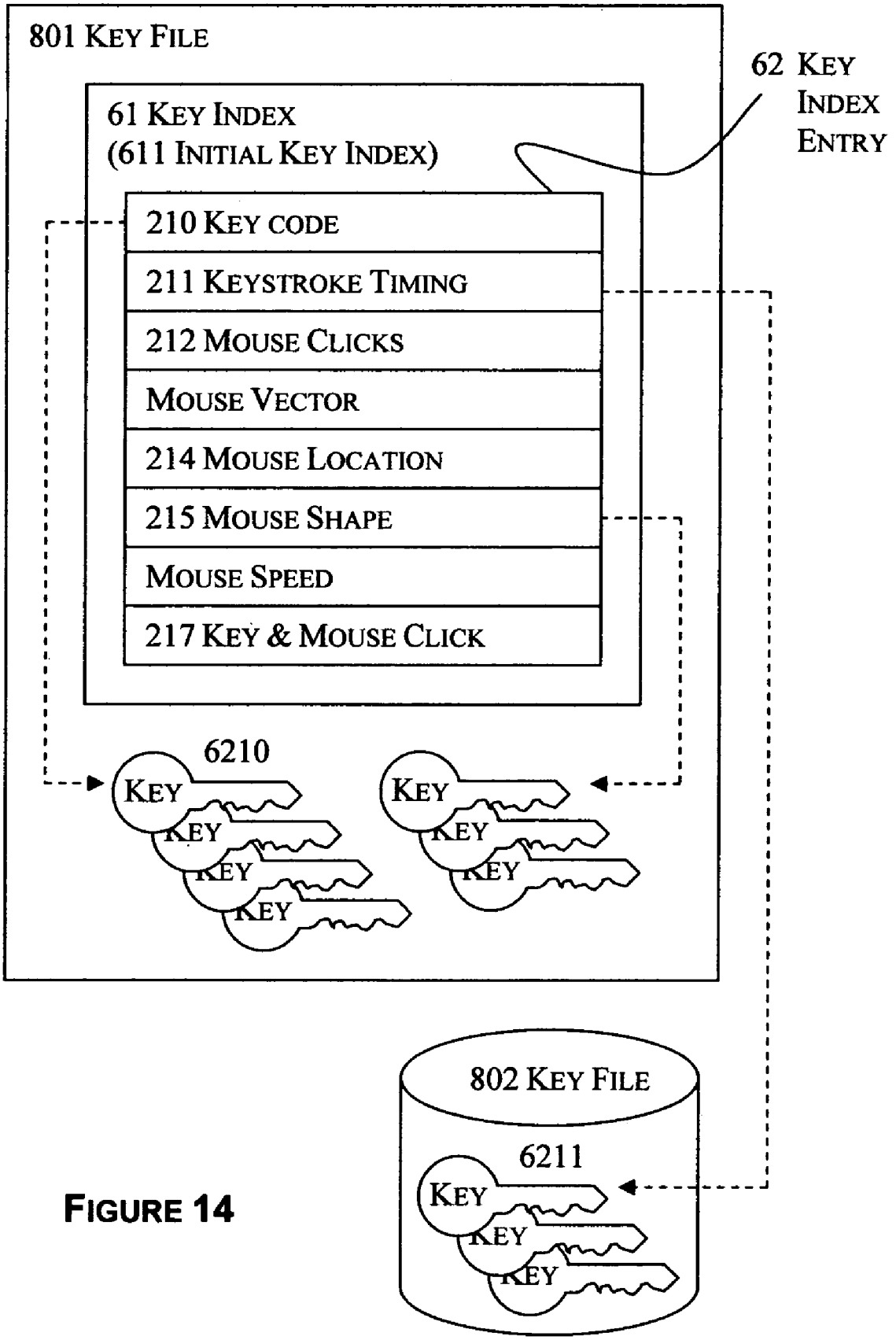
801 KEY FILE
62 KEY INDEX ENTRY
61 KEY INDEX
(611 INITIAL KEY INDEX)
210 KEY CODE
211 KEYSTROKE TIMING
212 MOUSE CLICKS
MOUSE VECTOR
214 MOUSE LOCATION
215 MOUSE SHAPE
MOUSE SPEED
217 KEY & MOUSE CLICK
6210
KEY
KEY
KEY
KEY
KEY
KEY
KEY
802 KEY FILE
6211
KEY
KEY
KEY

FIGURE 14

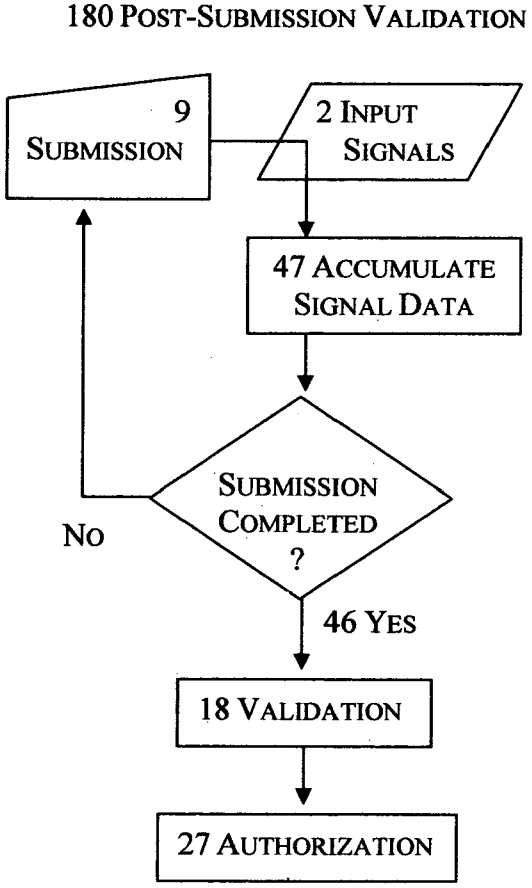

FIGURE 15

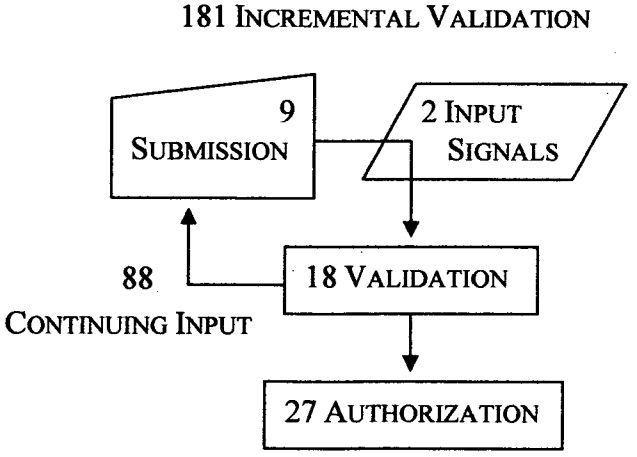

FIGURE 16

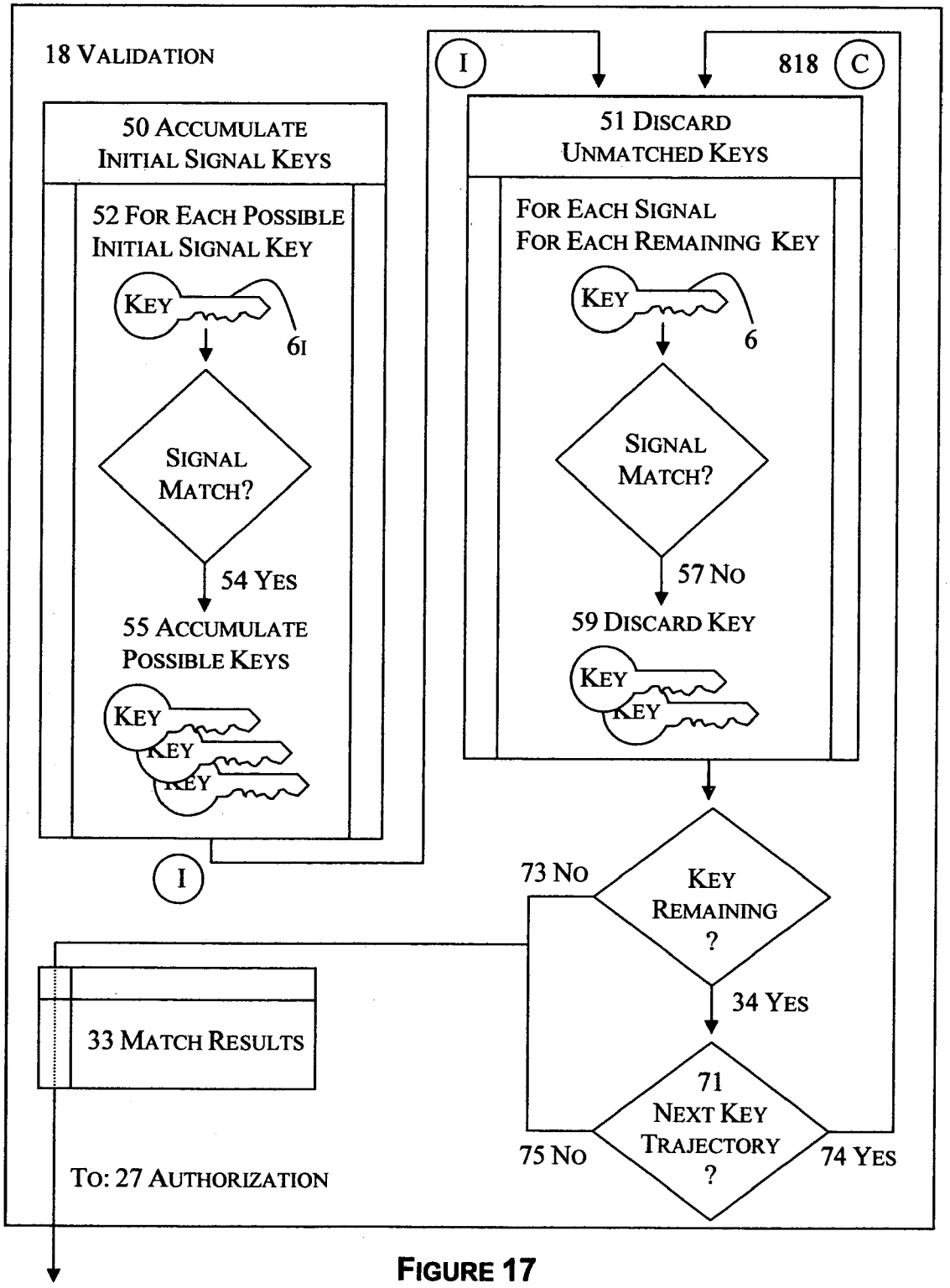
18 VALIDATION
I
818
C
50 ACCUMULATE INITIAL SIGNAL KEYS
52 FOR EACH POSSIBLE INITIAL SIGNAL KEY
KEY
6I
SIGNAL MATCH?
54 YES
55 ACCUMULATE POSSIBLE KEYS
KEY
KEY
KEY
I
51 DISCARD UNMATCHED KEYS
FOR EACH SIGNAL
FOR EACH REMAINING KEY
KEY
6
SIGNAL MATCH?
57 NO
59 DISCARD KEY
KEY
KEY
73 NO
KEY REMAINING ?
34 YES
71 NEXT KEY TRAJECTORY ?
75 NO
74 YES
33 MATCH RESULTS
TO: 27 AUTHORIZATION

FIGURE 17

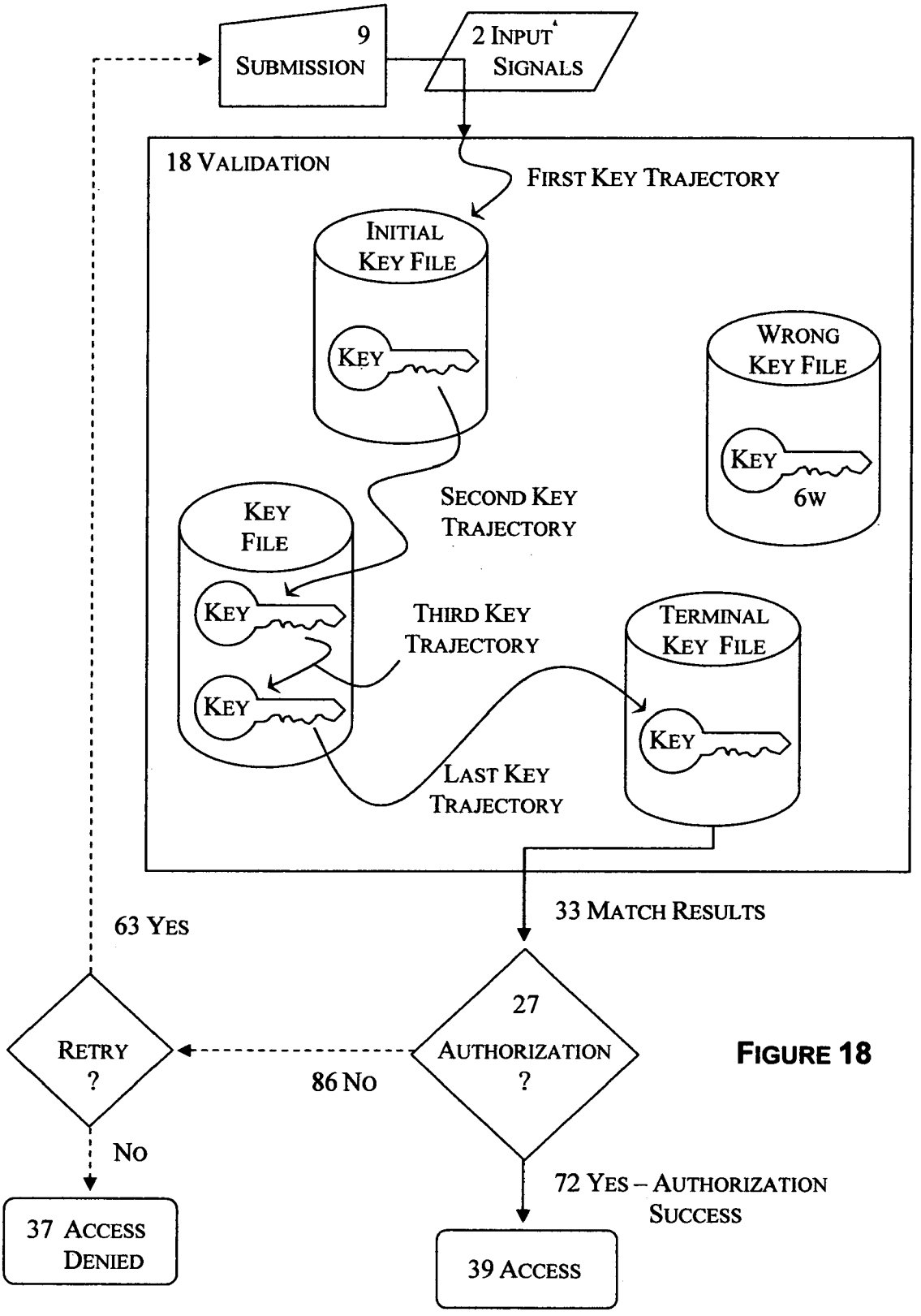
9
SUBMISSION
2 INPUT SIGNALS
18 VALIDATION
FIRST KEY TRAJECTORY
INITIAL KEY FILE
KEY
WRONG KEY FILE
KEY
6W
KEY FILE
SECOND KEY TRAJECTORY
KEY
KEY
THIRD KEY TRAJECTORY
TERMINAL KEY FILE
KEY
LAST KEY TRAJECTORY
33 MATCH RESULTS
63 YES
27
AUTHORIZATION ?
RETRY ?
86 NO
NO
72 YES – AUTHORIZATION SUCCESS
37 ACCESS DENIED
39 ACCESS

FIGURE 18

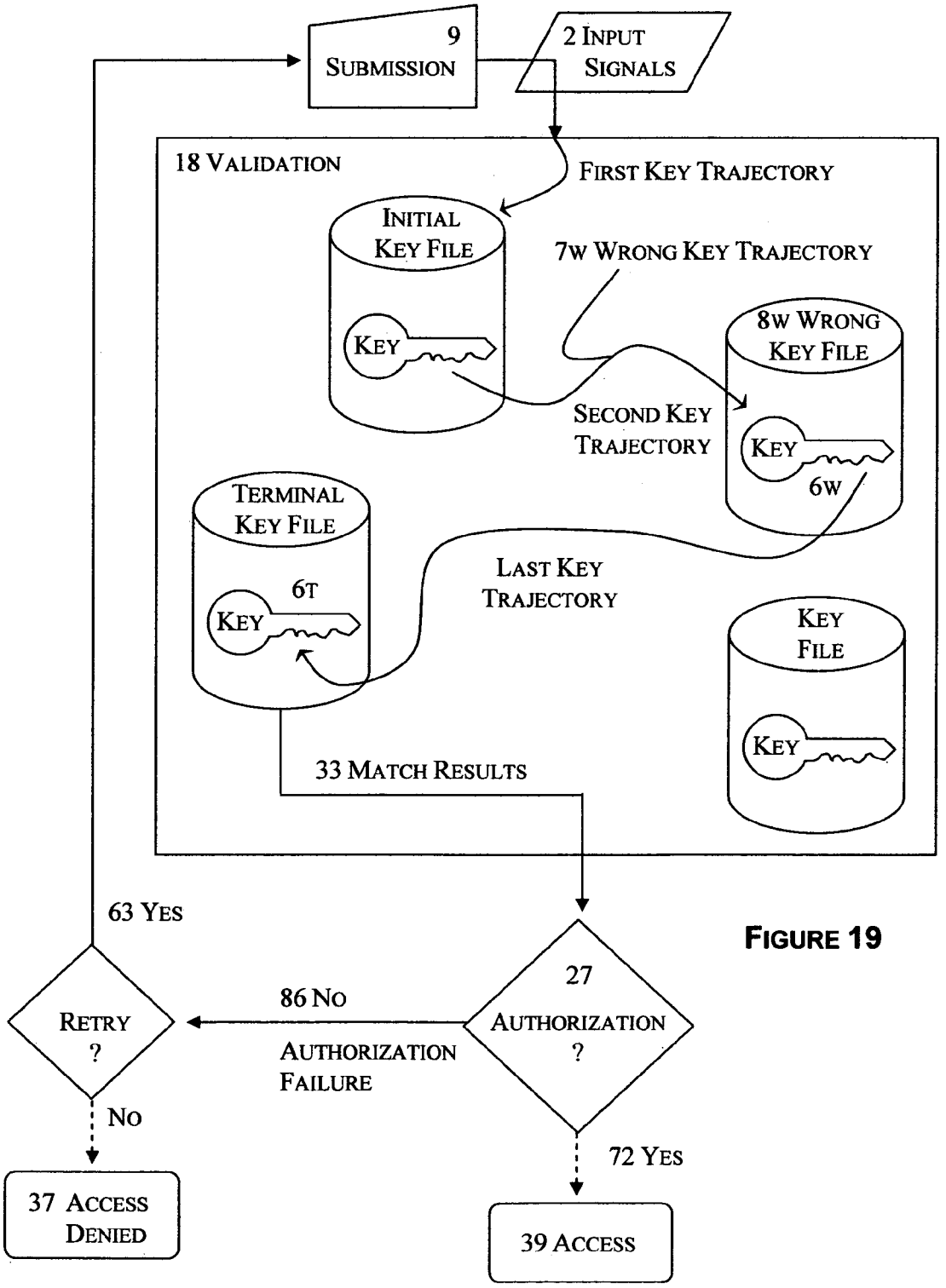
9
SUBMISSION
2 INPUT SIGNALS
18 VALIDATION
FIRST KEY TRAJECTORY
INITIAL KEY FILE
KEY
7W WRONG KEY TRAJECTORY
8W WRONG KEY FILE
SECOND KEY TRAJECTORY
KEY
6W
TERMINAL KEY FILE
6T
KEY
LAST KEY TRAJECTORY
KEY FILE
KEY
33 MATCH RESULTS
63 YES
27
AUTHORIZATION ?
86 NO
AUTHORIZATION FAILURE
RETRY ?
NO
72 YES
37 ACCESS DENIED
39 ACCESS

FIGURE 19

USER SELECTION OF COMPUTER LOGIN

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority from provisional application 60/286,457, filed on Apr. 26, 2001.

BACKGROUND

Computer login traditionally consists of a user typing in an account name and a password.

Historically, access validation, such as authenticating a password for an account, has been through reading data from a single password file comprising account name and encrypted password. Once a single account and a typed password is known, system security can be compromised. Once encryption for a single password is broken, all other passwords are potentially comprised, as all passwords and account names are conveniently located in the single password file and use the same encryption.

U.S. Pat. No. 6,442,692 [Zilberman] disclosed a special microcontroller embedded within a keyboard. The microcontroller was employed "to measure certain characteristics of the user's keystroke dynamics" independent of the typed text, including the timing, intervals, and durations of key presses and pauses. These measured characteristics were then used as integral information for authenticating a user's identity.

U.S. Pat. No. 6,766,456 [McKeeth] disclosed user input from one or a combination of input devices as a basis for user authentication. McKeeth used matching of "implicit input" as part of the authentication, where the implicit input is related to the timing and/or duration of explicit inputs.

Zilberman and McKeeth used surreptitious surveillance of user input, where the user could not choose or control data vital to authentication. McKeeth disclosed the possible usage of multiple input devices, used singularly or in combination, but only disclosed that "the computer system may be configured," never anticipating that a user may choose the input device configuration.

SUMMARY

Computer login may comprise any user-determined submission, including a plurality of transmissions for which submission may be passively terminated. Preferably a user determines the signal types as well as content of signals. This makes submission theft more difficult and less likely.

Account identification may be inferred by signature rather than explicitly stated. Overt account identification provides an entry point for hacking; with inferred account identification, this entry point is eliminated.

A plurality of discontiguous data blocks (keys) in a one or more files may be employed for validation. This ameliorates having a single authentication key that, once accessed, may be deciphered and security compromised.

Multiple trajectories to keys, hence multiple paths to authorization as well as ersatz trajectories and paths when submission will not garner authorized access, obfuscate validation protocol to spy software and devices.

These aspects are independent: one does not rely upon the other. Any one or all may be employed to enhance computer login security.

Access privileges for accounts are not germane. Determining or setting account access privileges are separate operations that occur after submission validation and authorization.

DRAWINGS

FIG. **1** is a block diagram of a computer suitable for practicing the invention.

FIG. **2** depicts the access authentication process.

FIG. **3** depicts an embodiment of identification and signature comprising submission.

FIG. **4** depicts an embodiment of signature solely comprising submission.

FIG. **5** depicts classifying signals by their transmission and signal types.

FIG. **6** depicts simple and composite signals.

FIG. **7** depicts active submission termination.

FIG. **8** depicts passive submission termination.

FIGS. **9** & **10** depict example submission screens.

FIG. **11** depicts account creation.

FIG. **12** depicts a key.

FIG. **13** depicts a key unit.

FIG. **14** depicts an example of key indexing.

FIG. **15** depicts validation after submission termination.

FIG. **16** depicts incremental validation.

FIG. **17** depicts the validation process.

FIG. **18** depicts an example of validation key trajectory resulting in access.

FIG. **19** depicts an example of validation key trajectory resulting in authorization failure.

DESCRIPTION

FIG. **1** is a block diagram of a desktop computer **100** which comprises a CPU **102**; storage **103**, which comprises memory **104** and optionally one or more devices with retention medium(s) **105** such as hard disks, diskettes, compact disks, or tape; an optional display device **101**; and one or more input devices **106**, examples of which include but are not exclusive to: a keyboard **108**; one or more pointing devices **107**, such as a mouse; or a biometric device **109**, such as a fingerprint reader. The mouse is the most popular pointing device **107** for desktop computers **100**. In the description below, mention of a mouse is meant to include pointing devices **107** of any type, including, for example, a pen or stylus used in computing devices where a user may "write" upon a screen. The described software may be employed on such a computer **100**. As well, the software described may find application in other computer-like devices requiring secured access, including hand-held or embedded devices.

In the following description, software-determined protocol includes exemplary methods or techniques such as algorithms; or non-algorithmic methods or techniques, including, for example, fuzzy logic or neural network pattern matching; or, random or pseudo-random determinations. A random or pseudo-random technique that results in seemingly arbitrary selection, the equivalent of software rolling dice, is referred to as non-deterministic.

In the following description, protocols, algorithm types, data types, and types of data, such as transmission **11**, signal **21**, packaging **13**, sequencing **15**, or encryption **14** types or protocols, are identifiable using binary identification codes (type identifiers), by data length, or other data signature, such as a uniquely identifiable bit pattern, or by convention, such as known location (offset) within a data structure.

FIG. **2** depicts the access authentication process **97**, comprising submission **9**, validation **18**, and authorization **27**. Naturally, an account must be created **10** before any access authentication process **97** may occur.

Submission **9** comprises one or more transmissions **1** intended for authenticating access to a computer **100** or network of computers **100**. As depicted in FIG. **3**, in one embodiment, a submission **9** comprises identification **3** and signature **4**. Historically, an account name would be an identification **3**, and a password a signature **4**. If surety of uniqueness may be assured, in an alternate embodiment, a submission **9** comprises a single signature **4***s*, as depicted in FIG. **4**, supplanting separate identification **3** & signature **4***a* while providing for the dual components of identification **3** and signature **4**. With submission **9** solely comprising signature **4***s*, an account may be identified by the signature **4***s* data itself, or by having an account identifier **110** embedded within a key **6** that has been accessed during validation **18** of the signature **4***s*.

A transmission **1** is user input into the computer **100** via one or more input devices **106**, whereupon termination of transmission **1** is recognizable, and resulting in at least one signal **2**. There may be different types **11** of transmissions **1**, examples of which include mouse **107** movements or clicks, keyboard **108** entry, or combinations thereof. Other types **11** of transmissions **1** are possible with different input devices **106**, such as, for example, voice transmission **1** if the computer **100** is equipped with a microphone and speakers.

Multiple-device **106** transmission **1***m* is conceivable. An example of a multiple-device **106** transmission **1** is a combination of mouse **107** movement while one or more keys **108** are pressed, as depicted in FIG. **6**.

A signal **2** is a set of related software-recognizable data from a single transmission **1**. A plurality of signals **2** of different types **21** may emanate from a single transmission **1**. For example, typing a word may yield the signals **2** of entered keys **210** and the timing between keystrokes **211**. Another example: mouse **107** movement of the cursor may yield signals **2** of locations **214**, velocities, duration; and shape pattern(s) (such as script signatures, drawn characters, and so on) **215**.

A transmission **1** of composite signals **2***c* comprising a plurality of simple signals **2***s* is conceivable. For example, a multiple-device **106** transmission **1***m* produces a composite signal **2***c* if matching to signals **2** of both devices **106** is required, as does requiring signal match **5** of multiple signal types **21** from a single-device transmission **1**.

Signal data **22** may be categorized by its transmission type **11** and/or signal type **21**, as depicted in FIG. **5**. For easy identification, each possible transmission type **11** or signal type **21** may be assigned a unique ordinal. Hypothetically, if a multiple-device **106** transmission **1** is identified as a unique transmission type **11**, the range of transmission types **11** may extend to the factorial of all possible input devices **106**, depending upon the embodiment employed. To avoid unnecessary complication, consider signal type **21** as potentially additive (rather than combinatorial): for example, a key-mouse transmission **1** could be considered as comprising key **108** plus mouse **107** signals **2**, rather than some uniquely identifiable key-mouse signal type **21**.

Identification **3** is at least one transmission **1** of an account identifier. Historically, identification **3** has been a keyed-in account name. Employing the invention, identification **3** comprises at least one signal **2** from at least one transmission **1**. A translation table, algorithmic method, or other software-determined protocol, with or without encryption **14**, may be employed if identification **3** or signature **4***s* does not represent the actual account identifier.

A signature **4** is at least one transmission **1** intended as a security precaution to preclude unauthorized access **39**. Historically, a single signal **2** of a single transmission **1** has typically been used for a signature **4**, namely a password, which is a signature **4** of a single word of text. A pass-phrase is a signature **4** of a plurality of words of text.

A plurality of transmissions **1** or signals **2** may be used for identification **3** or signature **4**. In some embodiments, a user may determine the transmission(s) **1**, signal(s) **2**, transmission type(s) **11**, or signal type(s) **21** that comprise a submission **9**. Alternately, transmission **1** or signal **2** determination accords with a software-determined protocol.

Historically, validation **18** has required an absolute signal match **5** to input **22**: for example, no deviance from a character-based password has been permitted. With mouse **107** movements, or other difficult-to-exactly-replicate signals **2**, however, some tolerance may be permitted. Signal **22** tolerance should be allowed when appropriate, and may be set by software-determined protocol or user selection. For example, deviance up to 10% from recorded signal match **5** for keystroke timing **211** may be acceptable. Similarly, as another example, mouse click location may vary within a radius of 10 pixels and still be tolerated. As multiple signals **2** may comprise a submission **9**, the need for exactness for any single signal **2** to properly authenticate access **97** is lessened.

Termination of submission **9** may be active or passive. FIGS. **7** & **8** illustrate. Inputting a password or pass-phrase, for example, is typically terminated by pressing the 'Enter' key or clicking an equivalent acknowledge button **43** using the mouse **107**. As another example, inputting mouse **107** movement may be actively terminated by a mouse **107** click. With active termination **78**, a user terminates submission **9** through a prescribed indication **25**. With passive termination **77**, software terminates submission **9** without overt user action, but instead when a predetermined condition is met **26**. Examples of passive termination **77** include: recording mouse **107** movement or sound for a limited time, or until a certain elapsed time absent further input; until sufficient signal **2** has been input to allow a signal match **5**; or until a succeeding transmission **1** of another transmission type **11** or signal type **21** commences, the change of type **11** itself indicative of previous transmission **1** termination. For example, changing from cursor/mouse movement to mouse button clicking may be considered a change in signal type **21**, and hence a possible basis for passive termination. Biometric transmission **1** is typically passively terminated **77**: software terminates submission **9** when sufficient biometric signals **2** have been recorded.

Termination **23** of identification **3** or signature **4** may occur using any number of protocols: passively **77** by a predetermined or user-selected number of transmissions **1**; final transmission **1** by a particular type of action; active termination **78** by a final gesture, such a key or button press; passive termination **77** by time out of a predetermined duration or sufficiency of data collection. Another example: incremental validation **181** permits passive termination **77** via absence of next key trajectory **7**, or, alternately, completed signal matching **5** of all relevant keys **6**.

FIGS. **9** & **10** depict an example account input **99** or post-account creation submission **9** screen **40**, employed to input at least a signature **4**. (In one embodiment, account identifiers **3** may be assigned.) Text transmission(s) **1** can be input in the text input dialog **41** comprising a text input control **42** and acknowledge button **43**. Signature **4** transmission(s) **1** can be input, and input signals **2** recorded. FIG. **9** depicts dragging the text input dialog **41** down the screen **40** as a transmission **1** (by pressing the proper mouse **107** button when the cursor is over an appropriate section of dialog **41**, thus selecting the dialog **41**, then moving the

mouse **107** while keeping the button pressed). The dragging action in this example is terminated by a mouse-up (releasing the mouse **107** button).

In one embodiment, a user may determine as part of account creation **10** which signal types **21** are to be considered for validation **18** of subsequent submissions **9**. This is an editing process that may be construed as part of account input **99**. For example, after submission termination **23**, having recorded signals **2** for account input **99**, as depicted in the example of FIG. **10**, the user may select, via checkbox controls as shown, which signal types **21** of the transmission **1** depicted in FIG. **9** are to be considered for the transmission **1** being recorded. The checkboxes are specific to types of signals **21** appropriate to the type of transmission **11** employed. In the described example, the checkboxes (for signal type **21** selection) appear only for account input **99**, not when a user is making an submission **9** after an account has been created, as the prerequisite signals **2** for signature **4** or identification **3** have already been stored.

FIG. **9** depicts a button **25** for submission termination **78**. A termination button **25** or its equivalent is necessary only with active termination **78**. Initial input for account creation **10** may use active termination **78** which is later edited out during a subsequent signal **2** and transmission **1** selection process, resulting in passive termination **77**.

There is an embodiment whereby a user may determine some or all of the transmissions **1** or transmission types **11** comprising account input **99**. There is an embodiment whereby a user may determine which signal types **21** of select transmissions **1** comprise account input **99**. Otherwise, software-determined protocol may determine all or some transmissions **1** or signals **2** comprising account input **99**.

In one embodiment, account input **99** captures all transmission **1** signals **2** until actively terminated **78**. In an alternate embodiment, account input **99** may be passively terminated **77**. In one embodiment, transmissions **1** and signals **2** from account input **99** may be edited, the user selecting signals **2** and termination, such that only select, edited signals **2** and termination types are employed as account submission **9**. In alternate embodiments, as aspects of account input **99**, signals **2** may not be edited or user-selected, or termination **23** type user-determined.

FIG. **11** depicts account creation **10**, in the beginning of which account input **99** provides one or more signals **2** from one or more transmissions **1** for packaging into one or more keys **6**. Each user account has at least one key **6** for access authentication **97**.

There are two aspects to account creation **10**: packaging **13**, and key **6** creation or employment **16**.

Packaging **13** tells how to interpret keys **6**, including stored match signals **5**. Overt packaging **13** is optional, and may vary by embodiment. Packaging **13** may be implicit by software-determined protocol, obviating the need for overt, data-based packaging **13**. There may be two optional aspects to packaging **13**: encryption **14** and signal sequencing **15**.

Encryption **14** refers to encrypting or decrypting all or part of key **6** data. Encryption **14** is optional, but recommended. Encryption **14** employment may vary by embodiment. In one embodiment, the same encryption **14** protocol or algorithm is used throughout (thus, predetermined). In alternative embodiments, encryption **14** may vary by software-determined protocol or by user selection on a per-user or per-signal **2** basis. If a plurality of protocols are used for encryption **14**, the protocol **14** employed must be identifiable.

As a suggestion for encryption **14**, initial input signals **2** in the first transmission **1** may comprise a parametric seed for encrypting one or more keys **6**. Caution is advised if non-exact signal matching **5** is tolerated, as close may not good be enough for decryption using such a seed technique, but it is possible to incorporate tolerance into an encryption **14** algorithm, so that an acceptable margin of error for signal matching **5** may also suffice for decryption as well. Mathematical rounding is a suggested technique allowing such tolerance; as well employing a subset of possible signals **2**, such as a high and low, or using one or more algorithmically-derived values, such as median or mean.

Signal sequencing **15** is codification of the order of signals **2**. Signal sequencing **15** may be predetermined (software-determined), such as, for example, input order, or, alternately, a predetermined prioritization. In alternative embodiments, signal sequencing **15** may vary by software-determined protocol or by user selection. If a plurality of protocols are used for signal sequencing **15**, the protocol employed must be identifiable.

Sequencing **15** and encryption **14** may be combined, offering further opportunity for obscuring decipherment of packaging **13** protocols.

During account creation **10**, each selected signal **2** is optionally encrypted **14**, encoded for subsequent signal matching **5**, and stored in keys **6**, which are stored in key files **8**, for subsequent access authentications **97**.

As in the prior art, each account must be unique. For accounts where submission **9** comprises identification **3** and signature **4***a*, identification **3** must be unique. For accounts where submission **9** comprises signature **4***s*, the signature **4***s* itself must be unique. During account creation **10**, this can be verified by attempting to validate **18** the appropriate component of a submission **9** for a new account prior to establishing the account **10**.

A key **6** may contain account identification **3**.

As depicted in FIG. **11**, a key unit **16** is a virtual or actual collection of signal matches **5**. As in one embodiment a single key **6** may have a plurality of signal matches **5**, and thereby function as a plurality of keys **5** in alternate embodiments, a key **6** may comprise a key unit **16**. A key file **8** as an actual or potential collection of keys **6** a key unit **8**. An established account may be considered a virtual aggregation of the keys **6** used to validate **18** submission **9** for that account, hence also represents a key unit **16**.

A key file **8** comprises at least one key **6**. A key file **8** may comprise a plurality of keys **6**, or what deceptively may be keys **6**: a key file **8** may have pseudo-keys as key file **8** filler. In one embodiment, key files **8** may be a uniform number of bytes, regardless of the number of keys **6** stored in a key file **8**. Keys **6** may be in files **8** not exclusively comprising keys **6** (or pseudo-keys); in other words, a key file **8** may as well be employed for other purposes, including files **8** comprising unrelated data or even executable code.

As depicted in FIG. **12**, a key **6** may comprise packaging **13**, at least one signal match **5** facility, and at least one next key trajectory **7**. In alternate embodiments, key **6** composition varies; the minimum requirement is that a key **6** comprises at least one signal match **5**. Packaging **13** and next key trajectory **7** inherency may vary.

A signal match **5** is a signal **2** stored in a key **6** during account creation **10**, used for validation **18** of a subsequent submission **9** signal **2**. A key **6** may comprise a plurality of signal matches **5**.

A next key trajectory **7** vectors validation **18** to the next key **6**, or, if the terminal key **6***t*, results in forwarding match results **33** for authorization **27**, by absence of next key

trajectory **7** in one embodiment. Next key trajectories **7** are a sequential organizational facility for keys **6**.

Next key trajectories **7** may be obviated by having a single key **6** with sufficient contiguous signal matches **5** for validation **18**, whereupon the signal matches **5** within the key **6** are sequenced, organized, indexed, or otherwise knowable by software-determined protocol in relation to packaging **13**.

As the correspondence of signal match **5** to key **6** varies by embodiment, so too where a next key trajectory **7** leads. Depending upon restrictions that may be imposed in an embodiment, a next key trajectory **7** may lead to a key **6** in the same key file **8** as the last key **6**, a key **6** in another key file **8**, or the same key **6** if the key **6** holds a plurality of signal matches **5**.

Next key trajectory **7** provides all or part of a reference to the next key **6** used in validation **18**, if there is a next key **6**. A next key trajectory **7** may be encrypted **14**.

A next key trajectory **7** may be combined with other data that may have been or need to be mathematically transposed to determine the next key **6**. For example, all or a portion of an account identifier **3**, part of a signal match **5**, or some portion of packaging **13** may be combined with the next key trajectory **7** as a next key **6** identifier. Next key trajectory **7** may comprise or reference an offset in a key file **8**. A next key trajectory **7** may reference a key index entry **62**.

A key **6** may include a plurality of next key trajectories **7**, in which case a different next key trajectory **7** may be selected based upon signal match **5** results—one or more next key trajectories **7** for a correct signal match **5**, likewise for an wrong signal match **5**. With a plurality of next key trajectories **7**, a next key trajectory **7** may be selected based upon signal match **5** results, or by software-determined protocol, or a combination thereof.

Packaging **15** may be encoded as part of the next key trajectory **7**. For example, a next key trajectory **7** may include the signal sequencing **15** that identifies next signal match **5** type **21**. In this instance, if the next input signal **2** cannot be of the same type **21** as the next signal match **5**, authorization **27** may fail **86**. Knowing that at that point, a wrong trajectory protocol **7***w* may be invoked to avoid identifying a proper key unit **16**.

A submission **9** comprising identification **3** followed by signature **4***a* is easier to validate **18** than a submission **9** solely comprising signature **4***s*: knowing an account identifier **3** provides the means to know what the signature **4***a* should be.

Historically, identification **3** has not been relied upon for security. Signature **4** has played gate-keeper to unauthorized access **39**, not account identification **3**.

An initial key **61** that may ultimately lead to authorized **27** access **39** must associate to an account, either directly or by reference. There may be keys **6** for which authorization **27** cannot succeed **86** that may not associate to an account for which access **39** may be obtained. A key unit **16** for which authorized **27** access **39** is unobtainable is referred to as a fake key **6***w*.

Organize key units **16** as an optmization. Various conventions of organizing or indexing accounts, keys **6**, and key files **8** may be employed. In alternate embodiments, the same organizing principles may be applied at the level of key **6**, key file **8**, or account.

Optimally, keys **6** are organized to facilitate rapid search for signal matches **5**, particularly for finding initial signals **21** when submission **9** solely comprises signature **4***s*. Keys **6** may be sorted. For example, keys **6** for initial signals **21** may be arranged in binary sorted order by signal type **21** and signal **2**.

Key files **8** may be organized by account, or by transmission type **11**. Key files **8** may be organized by signal type **21**, with keys **6** within files **8** organized by input ordinal. Alternately, an initial key file **81** may comprise all possible initial keys **61** (of first signal matches **5**), possibly organized or indexed by signal type **21**. One or more key files **8** may contain one or more indexes **61** to keys **6** within their respective files **8**.

A key file **8** may include an index **61**, or key files **8** themselves be indexed. The next key trajectory **7** may provide next key **6** lookup via an index **61**. A key file **8** may include an index **611** to initial signal keys **61**. The index **61** may comprise key trajectories **7**, including key trajectories **7** to possible first keys **61**, which may be organized by transmission type **11** and/or signal type **21**.

FIG. **14** depicts an example of key **6** indexing. Key **6** indexing **61** or organization is recommended when submission solely comprises signature **4***s* where a user may input signals **2** in any user-determined manner. Depicted in FIG. **14** is a key file **801** with a key index **61**, specifically an initial key index **611**. The depicted initial key index **611** contains references to keys **61** that contain at least initial signals **2**.

In the FIG. **14** example, only initial keys **61** are indexed. In this example, checking possible initial keys **61** constitutes initial key trajectory **71**. One or more next key trajectories **7** in an initial key **61** may indicate keys **8** for succeeding signal matching **5**, like links in a chain, so only an index of initial keys **61** is required. Alternately, a single key **6** may contain all necessary signal matches **5** for validation **18**.

A key index **61** may reference keys **6** in different files **8**. As depicted in the FIG. **14** example, initial key index **611** entries **62** reference keys **6** of the same input signal type **21**. Initial key code keys **210**, for example, reference keys **6210** in the same file **801** as the index **611**, while keystroke timing keys **6211** referenced by the keystroke timing index entry **211** reside in another key file **802**. Key indexing **61** is an optimization.

A key code & mouse click key index entry **217** is depicted in FIG. **14** as an example of a composite signal **2**. The key code & mouse click key index entry **217** may reference keys **6** comprising multiple signal matches **5**, one for each simple signal **2** (key code **210** and mouse click **212**), or, alternately, reference multiple keys **6**, each with simple signal matches **5** that altogether comprise the composite signal **2**.

Without key file **8** organization or key indexing **61**, more keys **6** may need to be considered than just those keys **61** for initial signal matches **5**. With next key trajectories **7** referring to subsequent keys **6**, optimally, only potential initial keys **61** need be searched to commence validation **18**.

FIG. **15** depicts post-submission validation **180**: input signals **2** are accumulated **47** and submission **9** completed **46** before validation **18** commences. FIG. **16** depicts incremental validation **181**: validation **18** is concurrent with submission **9** transmission **1**. In other words, with incremental validation **181**, validation **18** may progress with each signal **2** or transmission **1**.

Submission termination **23** must be known using post-submission validation **180**. This is a potential drawback: unless software-determined protocol determines submission termination **23**, passive termination **77** cannot be accomplished using post-submission validation **180**; active termination **78** must be used. For full user-determined submission **9**, employ incremental validation **181**, which has the concomitant advantage of immediate knowledge of authorization failure **86**, allowing wrong key trajectory **7***w* protocol interposing.

FIG. **17** depicts the validation **18** process, which is similar regardless whether post-submission validation **180** or incremental validation **181** is employed.

Incremental validation **181** may commence once the first transmission **1** completes, or, in a more sophisticated embodiment, ongoing **88** with signal input **2**. In a concurrent

validation **181** embodiment, initial signal keys may be accumulated **50** and subsequent unmatched keys discarded **51** concurrent with transmission **1**, on a signal-by-signal **2** basis.

Validation **18** commences by accumulating possible keys **55** based upon signal match **54** between signals **2** of the first transmission **1** and possible initial signal keys **52**. For subsequent transmissions **1**, accumulated keys are discarded **59** by failure to match signals **57**. Match results **33** are passed to authorization **27** when there are no keys remaining **73** or no next key trajectories **7** for remaining keys **75**. As long as there are remaining keys **34** with next key trajectories **74**, the process of discarding keys that don't match **51** continues **818**.

FIGS. **18** & **19** depict examples of the access authentication **97** process. FIGS. **18** & **19** illustrate an example of one-to-one correspondence between signal match **5** and key **6**. Through access to one or more keys **6** which may reside in one or more key files **8**, validation **18** produces signal match results **33**, upon which authorization **27** permits access **29**, allows retry **28** of submission **9**, or denies access **37**.

Full submission **9** comprises a set of signals **2** upon which access **39** may be granted **72**. Incomplete submission **9** comprises a set of signals **2** to which additional user input is ongoing **88**, and for which by themselves **2** authorization **27** would not succeed **86**.

In an example depicted by FIG. **18**, the first trajectory **71** is to a key **61** in a key file **81** determined by signal type **21**. Keep in mind that this process may be repeated for all possible initial keys **61**. For example, consider key **108** transmission **1** input **2**, with two possible corresponding signals **2**: key (character) codes **210**, and timing of key strokes (rhythm) **211**. As an example, a key unit **16** of key code signal type **21** might be accessed to search keys **6** for signal matches **5** of key code **210** signals **2**. It may be, for example, that user-selected signal selection was employed, with initial key code **210** signals **2** for the first input to be ignored, and key rhythm **211** used. A key code **210** match **5** may be found, but it would be wrong in this example, though with incremental signal matching **5**, this would not be known at first. A key unit **8** of key rhythm **211** signal types **21** would also find a match **5** after the second key code (as rhythm is the timing between successive keystrokes), this time (in this example) for the correct user. In this example, the key **6** with rhythm **211** signal match **5** may have sequence packaging **15** indicating that key code **210** is ignored for this transmission **1**. So, in this example of incremental validation **181**, initial signal input **2** has multiple signal matches **5**, narrowing possibilities in the initial transmission **1** to two possible accounts meriting validation **18** consideration. In this example, subsequent input signals **2** narrow validation **18** to a single account by a sequential process of elimination.

So, with incremental validation **181** there may need to be a plurality of input signals **2** before signal match **5** may effectively commence. In the example above, where key rhythm **211** is the first signal **2** to be matched **5**, two key code **210** signals **2** must be input before key rhythm **211** may even be considered.

In the example of FIG. **18**, validation **18** accesses three key files **8** through successive key trajectories **7**, bundling match results **33** for authorization **27**. In the depicted example, input signals **2** are validated **18** in input order interactively with input **2**. In other words, validation **18** is incrementally contemporaneous **88** with submission **9**. In an alternate embodiment with alternate sequencing **15**, input signal **2** validation **18** may not commence until submission **9** is completed **46**. The described example facilitates rapid authorization **27** by incremental validation **18**. Actually, while access **39** may marginally be accelerated by incremental validation **18**, only lack is authorization **86** is notably rapidly facilitated, as continued input **2** of a submission **9** that cannot possibly be validated **18** may be interrupted so that a user may retry **63**.

FIG. **19** depicts an example of an embodiment employing a wrong trajectory protocol **7***w*. Wrong trajectory protocol **7***w* is employed as a means of obfuscation targeted at computer monitoring devices. In the depicted example, keys **6** are constructed with multiple key trajectories **7**, with at least one trajectory to a succeeding key **6** whereupon authorization **27** may succeed **72**, and at least one trajectory **7***w* whereupon access **39** is hopeless (fake keys **6***w*). In the example, signal match **77** in the initial key **77** in the initial key file **81** mismatches. In this case, key trajectory **7***w* leads to a fake key **6***w* that cannot result in successful authorization **86**: whatever key **6** or key file **8** pinball is used, authorization fails **86**.

Trajectories **7** may be selected non-deterministically. This suggestion is most effective when there are multiple possible trajectories **7**, including wrong key trajectories **7***w*, that augur either for authorization success **72** or failure **86**.

For example, a key **6** may contain six next key trajectories **7**, three of which are wrong key trajectories **7***w*. Depending upon signal match **5** results, one of the three right or wrong trajectories **7** are non-deterministically chosen. This example presupposes sequences of keys **6** strung together by next key trajectories **7** that play out to authorization **27**. It is possible for different next key trajectories **7** to diverge to different (possibly duplicate) keys **6** that later converge back to the same key **6**.

As described, validation protocols **18** may vary, and different protocols may be combined. Multiple non-deterministic trajectory **7** paths, including wrong trajectory **7***w*, is one example. In some embodiments, validation protocol **18** authorizing **27** access **39** may use different trajectories **7**. Duplicate signal matches **5** in different keys **6** in the same or different key files **8** may be employed to have various paths to authorization **27**. As another suggestion, different signal sequencing **15** may be employed to differ trajectories **7**.

The invention claimed is:

1. A computer-implemented method for creating a signature for subsequent authentication comprising:

indicating to a user commencement of signature input recording;

recording user input signals by type from at least one user-selected device among a plurality of selectable user input devices,

wherein a signal comprises a set of related software-recognizable data of the same type received from at least one input device, and

wherein at least one user-selectable input device affords recording a plurality of signal types, and

wherein a signal type comprises a category, among a plurality of possible categories, of measurable variable input associated with at least one user-selectable input device;

terminating said recording;

creating a signature based at least in part upon said recording; and

storing said signature.

2. The method according to claim **1**, wherein said recording comprises signals from a plurality of user-selected devices.

3. The method according to claim **1**, further comprising receiving user selection of at least one signal type from a plurality of signal types associated with at least one user input device.

4. The method according to claim 1, further comprising passively terminating authentication comparison of a subsequent signature submission to said recording,

thereby authenticating said subsequent signature; and

wherein said signature comprises at least in part signal input that is user-controllable in duration.

5. The method according to claim 1, further comprising:

comparing a subsequent signature submission to said recording,

and accepting said comparison within a predetermined degree of inexactness,

thereby authenticating said subsequent signature.

6. The method according to claim 5, wherein said predetermined degree comprises a user-designated tolerance.

7. The method according to claim 1, further comprising presenting at least a portion of said recording to said user for editing,

wherein said recording does not entirely comprise text-character codes.

8. The method according to claim 1, further comprising editing said recording,

wherein said signature is not entirely comprised of text-character codes.

9. A computer-implemented method for creating a signature for subsequent authentication comprising:

receiving user selection of at least one signal type among a plurality of selectable signal types;

recording input data of at least one signal type from at least one user-selected input device among a plurality of selectable user input devices,

wherein a signal type comprises a category, among a plurality of possible categories, of measurable variable input associated with at least one user-selectable input device,

and wherein at least one user-selectable input device affords recording a plurality of signal types; and

creating a signature comprising at least in part at least a portion of said input data of said user-selected signal types; and

storing said signature.

10. The method according to claim 9, wherein said recording comprises a plurality of user-selected devices.

11. The method according to claim 9, such that said recording precedes said receiving signal type selection.

12. The method according to claim 9, wherein at least one said signal type comprises input from a plurality of devices.

13. The method according to claim 9, further comprising:

comparing a subsequent signature submission to said recording,

and accepting said comparison within a designated tolerance of inexactness,

thereby authenticating said subsequent signature.

14. The method according to claim 9, further comprising editing said recording,

wherein said signature is not entirely comprised of text-character codes.

15. The method according to claim 9, wherein said recording comprises a plurality of user-selected signal types.

16. A computer-implemented method for incrementally authenticating a signature while receiving user input comprising:

receiving a first portion of user input data;

accumulating keys based upon matching correspondingly key data to said first portion of user input data,

wherein a key comprises at least in part a portion of a previously stored signature,

wherein said signature divisible into portions,

wherein said keys associating portions sequentially either integrally or by reference;

subsequently, iteratively receiving a plurality of portions of user input data and performing a corresponding authentication step for each portion,

wherein, upon receiving each subsequent portion after said first portion, discarding from further processing previously accumulated keys based upon failure in matching respective key data to said user input data portion; and

whereby continuing said iterative process until completing authentication by matching said last key to corresponding said user input data portion, or by process of elimination determining authentication impossible.

17. The method according to claim 16, wherein accepting said match within a designated tolerance of inexactness.

18. The method according to claim 16, wherein accessing at least one key by reference from another key.

19. The method according to claim 16, wherein said first portion comprises input from a plurality of devices.

20. A computer-implemented method for storing the signatures of a plurality of users comprising:

recording a plurality of signatures comprising data of a plurality of transmission types and signal types,

wherein a transmission type comprises indicia of a user-selected input device among a plurality of user-selectable devices,

wherein a signal type comprises a category, among a plurality of possible categories, of measurable variable input associated with at least one user input device, and

wherein at least two signals types are associated with at least one single input device; and

partitioning said signature data by transmission type and by signal type.

21. The method according to claim 20, further comprising storing a signature at least in part by partitioning said signature into portions by signal type,

such that at least one portion references another portion of said signature.

22. A computer-implemented method for creating a signature comprising:

recording user input of a plurality of signal types from at least one user-selected device among a plurality of user-selectable devices,

wherein a signal type comprises a category, among a plurality of possible categories, of measurable variable input associated with at least one user input device;

receiving user selection among those signal types recorded,

whereby receiving user selection of at least one less signal type than recorded for said device;

creating a signature comprising at least in part said user-selected signal types.

23. The method according to claim 22, further comprising receiving user indication to edit said signature,

wherein said signature is not entirely comprised of text-character codes.

* * * * *