US005930804A

United States Patent [19]

Yu et al.

[11] Patent Number: 5,930,804

[45] Date of Patent: Jul. 27, 1999

[54] **WEB-BASED BIOMETRIC AUTHENTICATION SYSTEM AND METHOD**

[75] Inventors: **Yuan-Pin Yu**, Sunnyvale; **Stephen Wong**, San Francisco; **Mark B. Hoffberg**, Palo Alto, all of Calif.

[73] Assignee: **Philips Electronics North America Corporation**, New York, N.Y.

[21] Appl. No.: **08/871,035**

[22] Filed: **Jun. 9, 1997**

[51] **Int. Cl.**[6] **G06F 9/00**

[52] **U.S. Cl.** **707/104**; 707/100

[58] **Field of Search** 707/1–205

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,229,764	7/1993	Matchett et al.	340/825.34
5,280,527	1/1994	Gullman et al.	380/23
5,615,277	3/1997	Hoffman .	
5,682,142	10/1997	Loosmore et al.	340/572
5,706,427	1/1998	Tabuki	395/187.01
5,719,950	2/1998	Osten et al.	382/115
5,757,916	5/1998	MacDoran et al.	380/25

FOREIGN PATENT DOCUMENTS

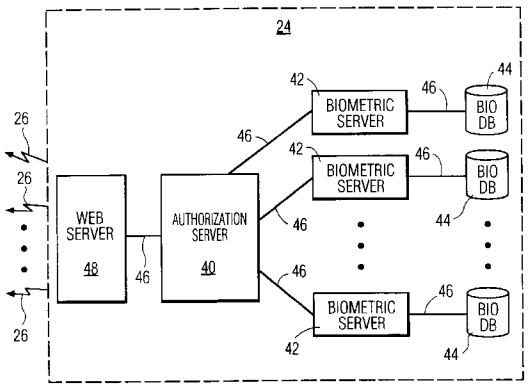
0762261A2	3/1997	European Pat. Off. .
9708868A1	3/1997	WIPO .

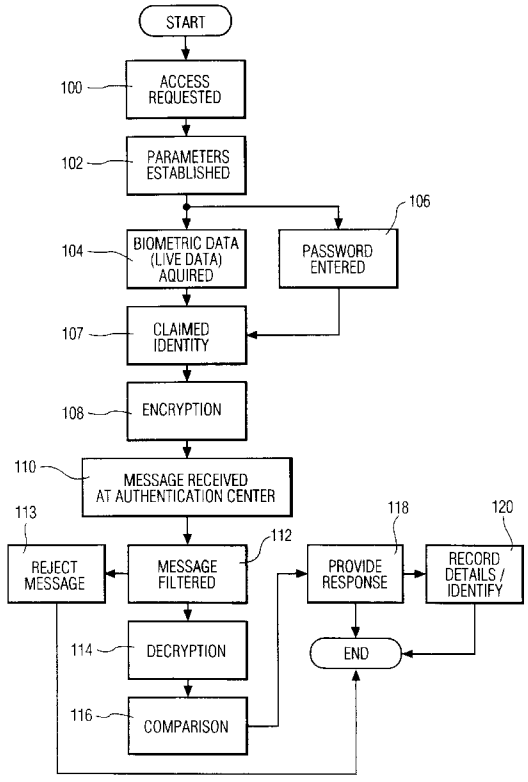
Primary Examiner—Paul R. Lintz
Assistant Examiner—John G. Mills, III

[57] **ABSTRACT**

A Web-based authentication system and method, the system comprising at least one Web client station, at least one Web server station and an authentication center. The Web client station is linked to a Web cloud, and provides selected biometric data of an individual who is using the Web client station. The Web server station is also linked to the Web cloud. The authentication center is linked to at least one of the Web client and Web server stations so as to receive the biometric data. The authentication center, having records of one or more enrolled individuals, provides for comparison of the provided data with selected records. The method comprises the steps of (i) establishing parameters associated with selected biometric characteristics to be used in authentication; (ii) acquiring, at the Web client station, biometric data in accordance with the parameters; (iii) receiving, at an authentication center, a message that includes biometric data; (iv) selecting, at the authentication center, one or more records from among records associated with one or more enrolled individuals; and (v) comparing the received data with selected records. The comparisons of the system and method are to determine whether the so-compared live data sufficiently matches the selected records so as to authenticate the individual seeking access of the Web server station, which access is typically to information, services and other resources provided by one or more application servers associated with the Web server station.

14 Claims, 4 Drawing Sheets





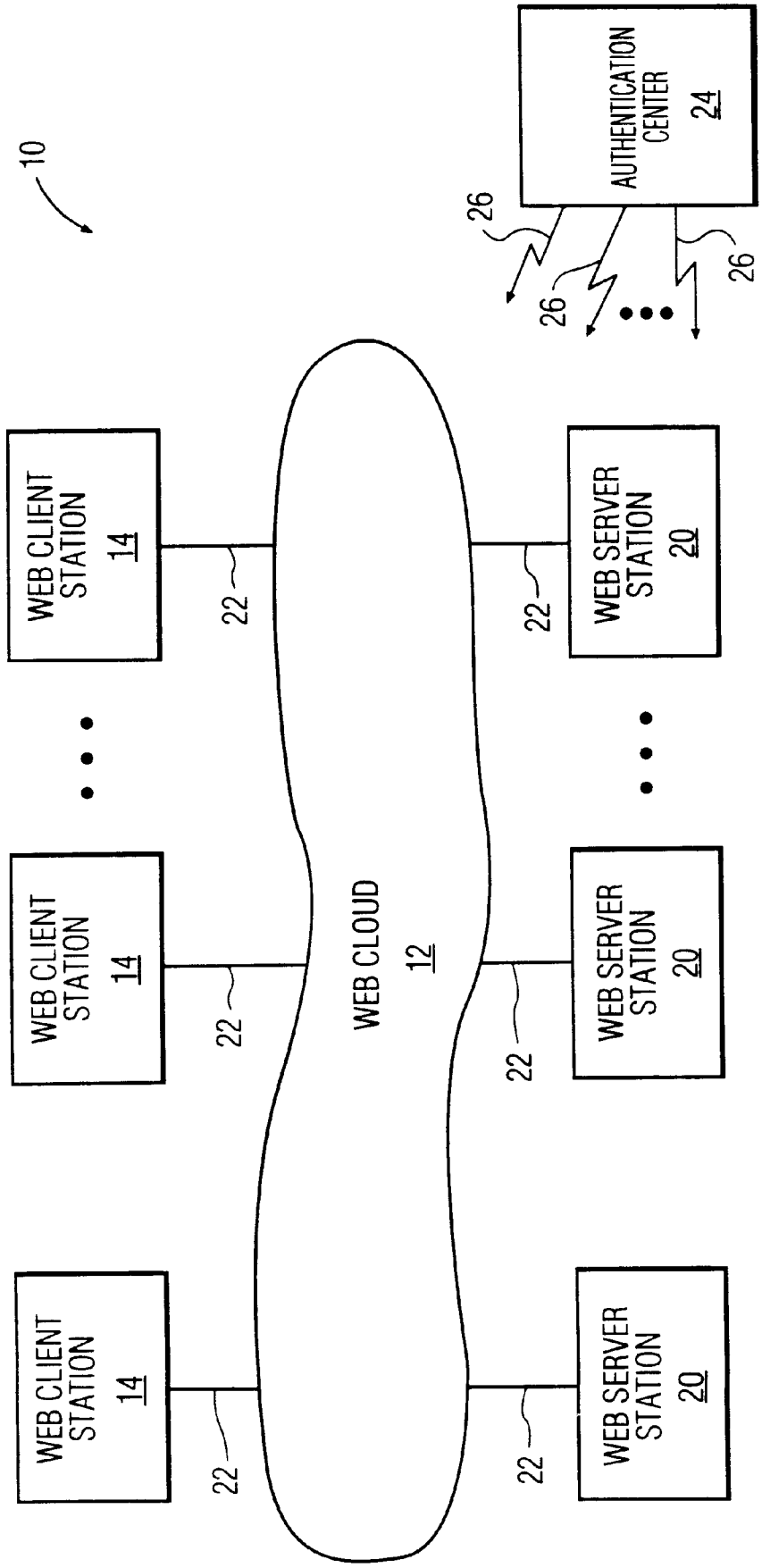

10
AUTHENTICATION CENTER 24
26
26
26
WEB CLIENT STATION 14
WEB CLIENT STATION 14
WEB CLIENT STATION 14
22
22
22
WEB CLOUD 12
22
22
22
WEB SERVER STATION 20
WEB SERVER STATION 20
WEB SERVER STATION 20

FIG. 1

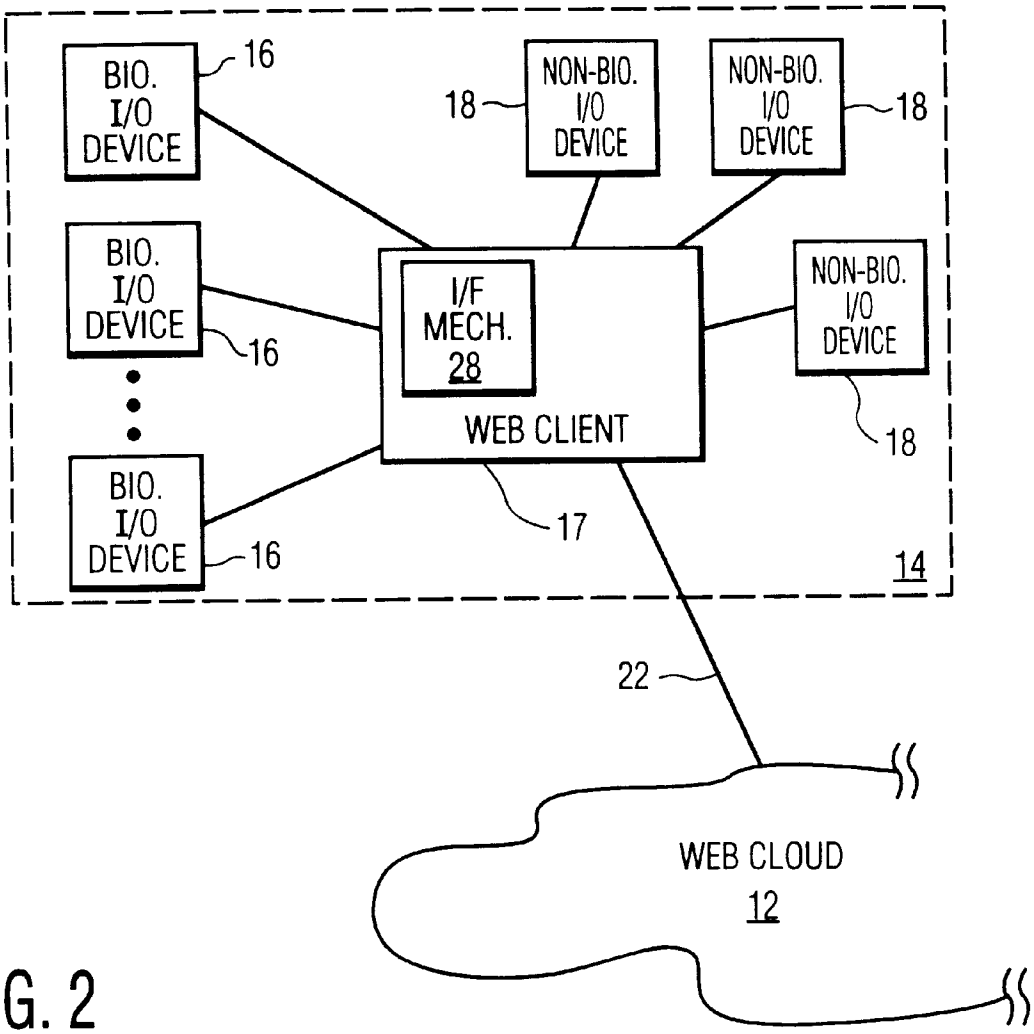

BIO. I/O DEVICE
16
NON-BIO. I/O DEVICE
18
NON-BIO. I/O DEVICE
18
BIO. I/O DEVICE
16
I/F MECH. 28
WEB CLIENT
NON-BIO. I/O DEVICE
18
BIO. I/O DEVICE
16
17
14
22
WEB CLOUD
12

FIG. 2

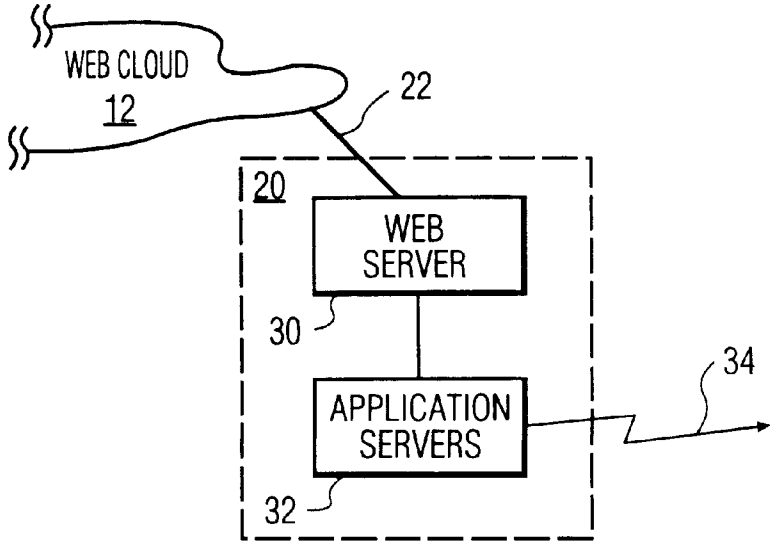

WEB CLOUD
12
22
20
WEB SERVER
30
APPLICATION SERVERS
32
34

FIG. 3

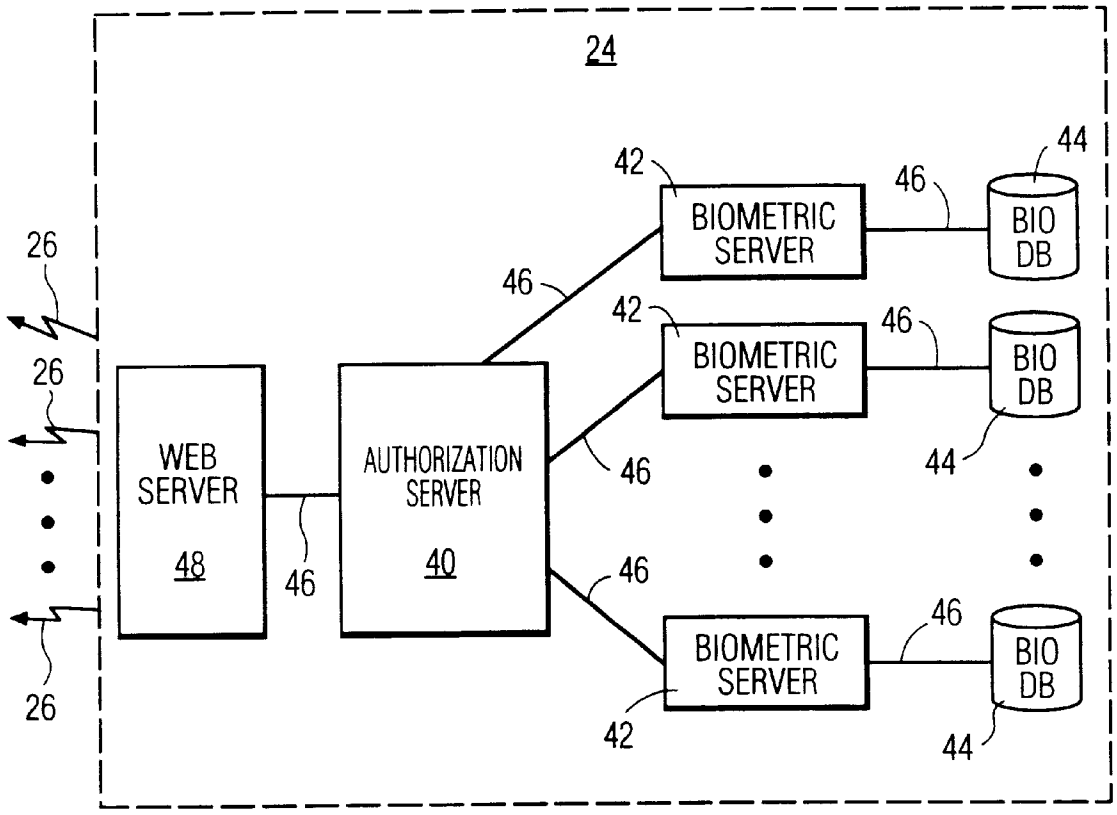

24
26
26
26
WEB SERVER
48
46
AUTHORIZATION SERVER
40
46
46
46
42
BIOMETRIC SERVER
42
BIOMETRIC SERVER
42
BIOMETRIC SERVER
46
46
46
BIO DB
BIO DB
BIO DB
44
44
44

FIG. 4

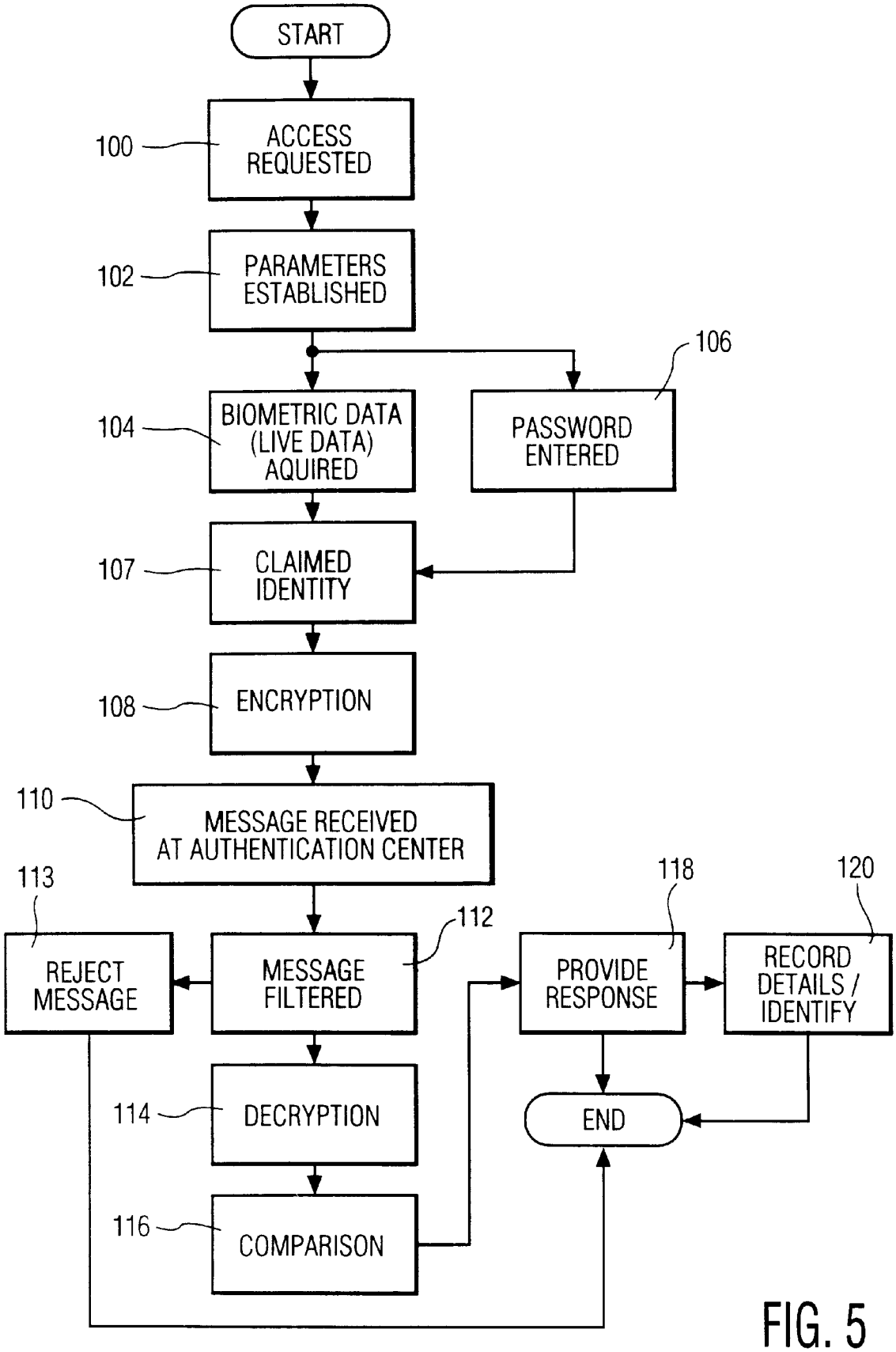

START
100
ACCESS REQUESTED
102
PARAMETERS ESTABLISHED
106
104
BIOMETRIC DATA (LIVE DATA) AQUIRED
PASSWORD ENTERED
107
CLAIMED IDENTITY
108
ENCRYPTION
110
MESSAGE RECEIVED AT AUTHENTICATION CENTER
113
118
120
112
REJECT MESSAGE
MESSAGE FILTERED
PROVIDE RESPONSE
RECORD DETAILS / IDENTIFY
114
DECRYPTION
END
116
COMPARISON

FIG. 5

WEB-BASED BIOMETRIC AUTHENTICATION SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

This invention relates to biometric authentication, particularly to systems and methods for biometric authentication of individuals involved in transactions employing the World Wide Web.

Broadly described, the World Wide Web (the "Web") is a decentralized, electronic database service offering a universe of dynamically connected information, the information being in any of various media and being relatively easily found by and made accessible to individuals exploring ("surfing") that universe ("Webspace"). More specifically, the Web is a distributed, hypertext system comprising hypermedia documents, Web servers and Web clients. Web clients include software programs commonly known as browsers. Browsers typically reside on an individual's personal computer and, among other things, provide for exploring the Web so as to find and access Web documents.

Web servers are software programs that support various features, including being compatible with one or more standard protocols, e.g., the HyperText Transport Protocol ("HTTP"), the well-known, native protocol of the Web generally unifying its information. Web servers put hypermedia documents on the Web and otherwise make resources associated with the server available to Web clients. Web servers not only make documents and resources accessible to Web clients, but also direct specific documents to clients and complete transactions responsive to each client's input. Web servers, being decentralized but interconnected, give the Web its distributed characteristic.

Web documents ("pages") are constructed in conformity with one of various accepted formats or languages, e.g., HyperText Markup Language ("HTML"). The formats support, among other things, the Web's hypermedia and hypertext characteristics. As to the hypermedia characteristic, Web documents can, and generally do, combine content from one or more of the various media including text, graphics, audio and video. As to the hypertext characteristic, Web documents can, and generally do, contain electronic links to related Web documents. Selecting the link causes the browser to (i) connect to a Web server associated with that link, (ii) request the linked document and (iii) if the Web client satisfies the server's security requirements, receive and display the document.

However described, the Web has had rapid acceptance and growth. The Web's growth is reflected by the number of Web servers going into service in a few years ago: in June 1993, 130 public servers; in November 1994, almost 9,000 public servers; in February, 1995, over 27,000 public servers. The number of servers currently is much greater still. The Web's acceptance is reflected by its application across institutions, whether government, corporate, commercial, education, civic or otherwise. Its acceptance and growth positions the Web to transform the way people create, access, and use information which, in turn, positions the Web to transform the institutions themselves.

The security of Web information and transactions has been identified as a significant problem. At the center of the problem are so-called crackers: individuals who seek to access computers, such as Web servers, so as to conduct pranks, vandalism, espionage or other illegitimate activities. Web security responds to these activities and, among other things, strives to maintain the confidentiality and integrity of information, both as resident on servers and as communicated in Web transactions. Increasing the vulnerability to crackers is that the Web is an open system available to anyone in possession of readily available, affordable technology.

One important Web security issue is authentication. While authentication takes various forms, authentication of individuals is particularly desirable. This authentication is directed to verifying that the individual seeking access to and/or through a Web server is in fact who that individual claims to be, and not an impersonator. This authentication relies on verification being performed at or above a predetermined minimum level of confidence. At the same time, authentication is generally an early hurdle that the individual must clear to conduct Web transactions with the server (typically the individual is subject to other security measures mediating access to system information, services and other resources).

The traditional method for authenticating individuals has relied on secret passwords. Password-only authentication has the benefit that it can be implemented entirely in software. However, password-only authentication has a number of disadvantages. First, passwords can be cumbersome. For example, a password's viability is enhanced, among other ways, by increasing its length, by controlling its composition and by its being frequently changed. However, using these techniques to enhance password viability tends to render the password increasingly cumbersome.

Second, passwords can be forgotten, lost, stolen or otherwise compromised. Password's that are written down are readily stolen. Passwords can be inadvertently disclosed to crackers via various ploys, including by crackers observing the password's entry on a keyboard. Passwords can also be illegitimately discovered by, for example, brute-force trial and error. Moreover, passwords can be intercepted as they are transported from the Web client to the desired server. Passwords can also be compromised by a cracker gaining access to a server's file of registered passwords which files generally are maintained to verify submitted passwords.

At least for these reasons, password-only authentication fails to provide adequate security. At the same time, Web-based applications are flooding into areas that can benefit from enhanced security. Examples of such Web-based applications include: commercial transactions (e.g., the purchase and sale of goods), banking transactions (e.g., electronic funds transfer), and medical transactions (e.g., provision of medical records in emergency situations).

Accordingly, a need exists for improved Web-based security measures, and methods to implement such measures. Moreover, a need exists for improved Web-based authentication systems and methods.

SUMMARY OF THE INVENTION

An object of this invention is to provide improved Web-based security measures, and methods to implement such measures and, moreover, to provide improved Web-based authentication systems and methods.

Accordingly to one aspect of the invention, a Web-based authentication system is provided that uses a Web cloud as a communication medium. The system comprises, in an embodiment, at least one Web client station, at least one Web server station and an authentication center. Access of (i.e., to and/or through) the Web server station via the Web cloud is sought by the individual using the Web client station, which access is dependent on authentication of the individual. The Web client station is linked to the Web cloud, and provides

selected biometric data representing biometric characteristics of an individual who is using the Web client station. The Web server station is also linked to the Web cloud. The authentication center is linked to at least one of the Web client and Web server stations so as to receive the biometric data provided by the Web client station. The authentication center which has records of biometric data of one or more enrolled individuals, provides for comparison of the provided data with selected records. The comparison is to determine whether the provided data sufficiently matches the selected records as to authenticate.

In another aspect of the invention, a method is provided for Web-based, biometric authentication of individuals who are using a Web client station, the individuals seeking access of (i.e., to and/or through) a Web server station. An embodiment of the method comprises the steps of (i) establishing parameters associated with selected biometric characteristics to be used in authentication; (ii) acquiring, at the Web client station, biometric data in accordance with the parameters; (iii) receiving, at an authentication center, a message that includes biometric data; (iv) selecting, at the authentication center, one or more records from among records associated with one or more enrolled individuals; and (v) comparing received biometric data with selected records, the comparison determining whether the so-compared biometric data sufficiently matches the selected records as to authenticate.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be made to the accompanying drawings and descriptive matter in which its preferred embodiments are illustrated and described, wherein like reference numerals identify the same or similar elements.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a block diagram of an embodiment of a Web-based biometric authentication system, according to the present invention;

FIG. **2** is a block diagram of a client portion of FIG. **1**, showing additional detail of the Web-based biometric authentication system, according to the present invention;

FIG. **3** is a block diagram of a server portion of FIG. **1**, showing additional detail of the Web-based biometric authentication system, according to the present invention;

FIG. **4** is a block diagram of the authentication center of FIG. **1**, showing additional detail of the Web-based biometric authentication system, according to the present invention; and

FIG. **5** is a flow-chart showing steps generally associated with authentication using a Web-based biometric authentication system, according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention contemplates Web-based biometric authentication systems and methods. Biometric authentication relies on the acquisition of data related to a biological feature so as to verify the claimed identity of an individual, generally in an automated methodology. Web-based authentication introduces the Web as the automation vehicle.

Authentication using biometric data exploits the fact that such characteristics (i) are relatively unique from individual to individual, (ii) are unchanging, and (iii) cannot be forgotten, lost, stolen, or otherwise compromised. In addition, non-Web-based authentication using biometric data has a substantial history and, accordingly, is relatively well-accepted in our society.

Authentication using biometric data, as described herein, is generally directed to verification that an individual is, in fact, who they claim to be. Broadly stated, verification generally compares the individual's submitted data, or data representative thereof (often referred to hereafter as "live data") to stored biometric data (often referred to hereafter as "records") associated with the person the individual claims to be.

However, it is to be understood that the systems and methods described herein is also directed to identification of individuals, without departing from the principles of the invention. By comparison to verification, biometric identification generally compares live data to the entire database of records so as to determine if there is a match and, if so, returns the identity of the person associated with the matching record. Biometric identification can be used in various applications, including, for instance, to identify unconscious individuals in need of medical attention and to identify crackers who seek or previously sought to breach a server or the authentication system itself (e.g., by matching live data to enrolled persons or by matching new enrollees to records of previous cracker attacks).

Authentication Systems.

As shown in FIG. **1**, a Web-based biometric authentication system **10** according to the present invention comprises a Web cloud **12**, one or more Web client stations **14**, one or more Web server stations **20**, Web connections **22**, an authentication center **24**, and one or more authentication center connections **26**. While the elements of the system **10** are shown as logical devices, one of ordinary skill in the art would readily understand that each is associated with respective physical devices. For example: (i) the stations **14** and **20** typically are associated with, among other physical devices, computers, such as PCs and servers; (ii) the connections **22** and **26** typically are associated, among other physical devices, with wires, cables, fiber optics, radio signals or other physical connections; and (iii) the Web cloud **12** typically is associated with, among other physical devices, network components such as routers, bridges, computers, internets, intranets, extranets and other physical networks.

The Web cloud **10** represents a generalized communication medium, based on and supporting standard protocols of the Web (e.g., HTTP), for Web transactions among the Web's clients and servers. It represents either the Web of hundreds of magazine and newspaper articles or any other Web, public or private.

The Web connections **22** link each of the Web client stations **14** to the Web server stations **20** via the interposed Web cloud **10** so as to provide Web communications there among. The Web connections **22** preferably support HTTP, as well as a secure transport protocol. The secure transport protocol preferably is the Secure Sockets Layer ("SSL"). SSL is an open, nonproprietary protocol offered by Netscape Communication Corporation of Mountain View, California ("Netscape"). SSL is designed for use by Web clients and servers, providing for data encryption, server authentication, message integrity and, optionally, user certificates. As to data encryption, SSL allows a client and server to negotiate an encryption algorithm, such as a public key algorithm (e.g., RSA), and to communicate securely using encryption.

Notwithstanding the above discussion, it is to be recognized that other protocols can be used without departing from the principles of the invention, provided that the protocols both support transport security and maintain overall operation of the system **10**. An example is the IIOP ("Internet Inter-ORB Protocol") of COBRA ("Collaborative Object Broker Request Architecture"), a standard specified by the OMG (Object Management Group)—a standard group of 700 computer and communication vendors that define distributed object computing interoperability).

The authentication center connections **26** preferably link the authentication center **24** to the Web cloud **12**, so as to provide communication between the center **24** and the stations **14**, **20**. The authentication center connections **26** support a secure transport protocol, such as SSL, so as to provide a secure channel. The authentication center connections **26** can also support a standard protocol, e.g., HTTP, although it is to be recognized that the system can be configured in the absence of that support.

The authentication center connections **26** are depicted in FIG. **1** so as to indicate that the link need not be via the Web cloud **12**. For example, the link can be made directly between the authentication center **24** and one or more of the Web client stations **14** and/or the Web server stations **20**. In the case of a Web cloud link, the system **10** takes advantage of the Web's scalability with respect to both Web client stations **14** and Web server stations **20**. In the case of a direct link, the system **10** takes advantage of the enhanced security generally associated with such links. In addition, the link can be both direct and via the Web cloud, which combination introduces the advantages of redundancy to those previously described, typically at only a marginal additional cost. It is to be recognized that each case is contemplated within the principles of the invention.

Turning to FIG. **2**, an exemplary Web client station **14** from FIG. **1** is shown in greater detail. The Web client station **14** comprises one or more biometric I/O devices **16**, one or more non-biometric I/O devices **18**, and a Web client **17**. Each of the devices **16** and **18** is linked to the Web client **17**. In addition, the Web client station **14** is linked via the connection **22** to the Web cloud **12** at the Web client **17**.

The Web client **17** preferably comprises any of the known browser programs, such as Netscape's Navigator-brand browser. Although browser programs are preferred, it is to be recognized that other Web clients can be used without departing from the principles of the invention, provided such clients are compatible with the system **10** and are able to perform the steps of an authentication method associated with the client station **14**, as described below. It is also to be recognized that the type of Web client **17** can vary among the Web client stations **14**, without departing from the principles of the invention.

The non-biometric I/O devices **18** preferably comprise products capable of inputting passwords and otherwise generating commands to control operation of the Web client **17**. Numerous such products are known, including mice, trackballs, keyboards, and microphones (with voice recognition software). Although the Web client station **14** preferably includes one or more non-biometric I/O devices **18**, it is to be recognized that the station **14** can omit such devices entirely, without departing from the principles of the invention.

The biometric I/O devices **16** comprise technologies that acquire selected data relating to biometric characteristics of the individual who is using the Web client station **14**. The technologies commonly include one or more known hardware sensors and associated software drivers (not shown). Under control of the associated software driver, the sensor produces a signal representative of variations in the biometric characteristic presented. If, for example, the sensor is a microphone used to capture a voice pattern, the microphone will produce a signal whose amplitude (voltage or current) varies with time in response to the varying frequencies in a spoken phrase (a "voiceprint"). In addition to microphones, other sensors are known, including (i) various scanners for acquiring finger print or retinal pattern data and (ii) typing pattern sensors associated with keyboards.

It is to be recognized that various of the biometric I/O devices **16** and the non-biometric I/O devices **18** can be implemented in single physical units, without departing from the principles of the invention. For example, a microphone can provide for input of non-biometric data via voice recognition software as well as biometric data in the form of voice prints. As an additional example, a physical keyboard can provide for input of non-biometric data as well as biometric data in the form of typing patterns.

The biometric I/O devices **16** preferably provide the acquired data in acceptable form to the Web client **17**, said form generally being representative of the acquired data. However, because the signals produced by most biometric sensors are analog, these signals generally are to be converted into digital form. To do so, an analog to digital converter ("ADC") typically is provided in association with the biometric I/O devices **16**. It is noteworthy that many personal computers—the typical physical host for a logical Web client station **14**—often provide an ADC operation in connection with integrated multimedia ports, e.g. microphone ports. Again, however, the logical representations of the Figures contemplate this integrated and any other disposition for the ADC and other physical devices, without departing from the principles of the invention.

Numerous products are known that can serve as biometric I/O devices **16**. For example, fingertip technologies are offered by (i) National Registry, Inc., of Tampa, Florida ("NRI") and (ii) Mytec Technologies of Toronto, Canada. In turn, voice print technologies are offered by iNTELiTRAK Technologies of Austin, Tex.

The Web client station **14** further comprises an interface mechanism **28**. The mechanism **28** receives the data acquired by the biometric I/O devices **16** which is provided to the authentication center **24** by the Web client station **14** via connection **22**, e.g. via SSL. Depending on the Web client **17** and the selected secure transport protocol, either the Web client **17** or the interface mechanism **28** perform the tasks associated with the secure transport protocol. In a hybrid embodiment, it is contemplated that the Web client **17** performs such tasks as to the communication between the Web client station **14** and the Web server station **20**, while the interface mechanism **28** performs such tasks as to the communication between the Web client station **14** and the authentication center **24**.

The mechanism **28** controls the biometric I/O devices **16** responsive to parameters associated with respective Web server stations **20**. These parameters preferably are received by the Web client **17** from the Web server station **20**. To do so, parameters preferably are included in a download of a page from the Web server station **20**, e.g., the station's home page as encountered by the Web client station **14** when initially seeking access. However, some or all of the parameters can be received otherwise, without departing from the principles of the invention.

The biometric I/O mechanism **28** preferably provides other functionality. For example, if the data received from

the biometric I/O devices **16** is in improper form, the mechanism **28** preferably is enabled to control conditioning the data to a proper form, said form generally yet being representative of the acquired data. Moreover, the mechanism **28**, in conjunction with the biometric I/O devices **16**, preferably supports safeguards against biometric forgery, e.g., temperature sensing for fingerprint scanning. In addition, the mechanism **28**, either with or without one or more of the biometric I/O devices **16**, preferably is enabled to process the biometric data so as to enhance the efficiency of the authentication methods. The processing includes, for example, extracting unique features of the data and/or otherwise compressing the data. Although these and other functions are preferred, it is to be recognized that the mechanism **28** may include or omit one or more of the described functions or include additional functions, without departing from the principles of the invention.

The interface mechanism **28** preferably comprises one or more plug-ins to the browser program. Each plug-in can be associated with biometric data of single or plural types. In this manner, the mechanism **28** provides for modification, either to expand or limit the variety of supported biometric characteristics. While the mechanism **28** preferably supports biometric data of all, or substantially all, types, it is contemplated that the mechanism **28** can be limited to fewer number of types (e.g., only voice or finger print data), without departing from the principles of the invention.

The interface mechanism **28** can also be implemented as a Java applet. As an applet, it can be downloaded, e.g., from the Web server station **20** in the page carrying parameters. Moreover, when the Web client **17** is closed, the applet generally is destroyed. (For the purposes of this application, plug-in implementations are referred to as non-destructive and Java applets are referred to as destructive.

FIG. **3** shows an exemplary Web server station **20** in greater detail. The Web server station **20** comprises a Web server **30** for making information, services and other resources, including Web transactions, available to Web client stations **14**. The Web server **30** preferably implements selected aspects of the authentication process hereof. For example, the Web server **30** preferably provides parameters of the biometric characteristics applicable to the Web client station **14** seeking access and participates in establishing the secure transport protocol, e.g. SSL.

The Web server station **20** preferably is associated with one or more application servers **32**. For example, application servers **32** preferably are used to provide the information, services and other resources, including both Web and non-Web transactions, sought by an individual using the Web client station **14**. The application servers **32**, when used, generally have functions that depend on the entity operating them. In the case of a bank, the application servers **32** can include, among others, e-mail servers (e.g., for customer service), electronic funds transfer gateways, and electronic bill delivery servers.

The application servers **32** link to the Web client stations **14** via the Web cloud or otherwise. The links can be through the Web server station **20** via connections **22** or outside the Web server station **20** via connections **34**. In this regard, it is to be understood that, although the application servers **32** are described and depicted in association with the Web client station **20**, this description and depiction is a logical association, in that the Web server **30** of the station **20** participates in authenticating individuals for access, such access typically being of the associated application servers **32**. As an example, any one or more of the application servers **32** can be physically remote from the other, as well as being physically remote from the Web server **20**. In keeping with the logical association, the Web server **30** and the application servers **32** generally are, but need not be, operated by the same entity (e.g., the Web server **30** can be operated by the entity that operates the authentication center **24**, which entity is other than that operating one or more of the application servers).

FIG. **4** shows an exemplary authentication center **24** in greater detail. The center **24** comprises an authorization server **40** linked via element connections **46** to one or more biometric servers **42**, each of which servers are, in turn, linked via element connections **46** to one or more associated biometric databases **44**. The authorization server **40** controls communication between the center **24** and the other system elements **10**. The biometric servers **42** compare the biometric data originating from the Web client servers **14**, or data representative thereof, with the stored biometric data of enrolled individuals, such records being stored in the biometric databases **44**.

The center **24** also can comprise a Web server **48**, although it is to be understood that the Web server **48** can be omitted without departing from the principles of the invention. The Web server **48** provides for communication via pages.

The element connections **46** preferably support a secure transport protocol, such as SSL, so as to provide secure channels among the center's elements. In certain configurations of the system **10**, element connections **46** support standard Web protocols, e.g., HTTP. Such configuration is contemplated, for instance, when the authentication center **24** is providing pages to the Web client station **14** relating to the authentication results.

Although FIG. **4** shows elements of the authentication center **24** logically together, it is to be recognized that the elements can be disposed at physically remote locations without departing from the principles of the invention. For example, any one or more of the biometric databases **44** can actually comprise plural databases, each physically remote from the other and physically remote from the associated biometric server **42**, which itself can be physically remote from the authorization server **40**.

Moreover, the authentication center **24** as a whole, or part or parts of it (e.g. the biometric databases **44**) can be captive, i.e., operated integral with, or by the same entity as, one or more of the Web server **30** and/or the application servers **32** of each Web server station **20**. In that structure, the entity can retain control over obtaining and maintaining the data, which can be important as the data generally comprises confidential information of their customers. In addition, the entity can make the data available to authentication centers **24** which are operated by different entities, either by providing copies of the databases or providing for access (e.g., via a secure channel) to the databases **44**. These circumstances are contemplated for application typically in large enterprises that have such databases, or those having relatively high security needs, such as banks, insurance companies, large health-care organizations and government units. (Hereafter, the term "captive structure" generally will be used to designate configurations in which one or more biometric databases **44**, with or without the authorization server **40**, are created and controlled by the entity operating the Web server station.) By comparison, the authentication center **24** can be operated independently from the Web server station **20**, i.e., operated neither integral with nor by the same entity as the Web server station **20**. In that

configuration, a different entity than that of the Web server station **20** typically controls the biometric databases **44**. These circumstances are contemplated for application typically in smaller enterprises that generally do not have such databases or those having relatively low security needs, such as stores. (Hereafter, the term "independent structure" generally will be used to designate configurations in which the biometric databases **44** are not created or controlled by the entity operating the Web server station **20**).

Operation and Methods.

The biometric authentication system **10** typically has two modes: enrollment and verification. In enrollment, individuals provide data to the authentication center **24** respecting their identity (e.g., by user name), by the Web location of the individual's Web client station **14** (e.g. a Uniform Resource Locator ("URL") or a network address), or by other identification token or a combination.

Preferably, enrollment includes confirmation, to a high degree of confidence and based on predetermined criteria, the individual's identity (i.e., that the individual being enrolled is, in fact, who that individual claims to be). Confirmation is generally accomplished by the entity operating the Web server station **20** in the captive structure. In the independent structure, confirmation is generally accomplished by the entity operating the center **24**.

Although confirmation to a high degree of confidence is preferred, it is also contemplated that the enrollment can be otherwise. For example, the invention contemplates building an enrollment database of biometric data wherein such data is obtained from Web client stations **14** via the Web connections **22**. For example, a Web-based store may opt to use such authentication, including as follows: the store receives an access request from an individual of a claimed identity; the individual's identity is authenticated based on biometric data previously enrolled via a Web connection; the store provides the goods; a subsequent access request is made from an individual claiming the identity of the previous access request; the individual's identity (a) is authenticated, such that new goods are provided only if payment was received for the previously-provided goods or (b) is not authenticated, such that new goods are provided if payment was not received for the previously-provided goods and, perhaps other factors (e.g., COD, value limits, etc.).

Enrollment preferably also includes an authorization check. Authorization can be to restrict system use to certain individuals. For example, authorization can be restricted to those who are members, clients, patients, etc. of the entity operating the Web server station or those who have paid some up front or continuing fees to use the service of the system **10**.

While its use preferably is subject to authorization, access to the authentication center **24** (e.g., its data and operations) generally is highly secured.

Enrollment includes acquisition of data representing one or more of the individual's biometric characteristics. The authentication center **24** also preferably acquires multiple data samples during enrollment, so as to account for variations typically encountered in acquisition (and in verification mode) and, thereby, to increase the reliability of authentication (i.e., reduce false negatives and positives).

Enrollment includes the storing of each enrolled individual's biometric data in association with the individual's identity, as confirmed. Enrollment can include other aspects without departing from the principles of the invention. For example, the biometric data can be examined to determine if biometric features are represented adequately to support reliable authentication. In addition, the individual's records can include an audit record of Web server stations **20** in connection with which the individual has been authenticated or is known to be authorized. In addition, enrollment can establish an encryption algorithm for communication between the center **24** and the client **14**. Moreover, enrollment can include certification that the biometric data is unique to the individual being enrolled, i.e. no one by a different identity has previously enrolled with that data.

In verification, the authorization server **40** receives encrypted messages carrying, for example, biometric data and the individual's claimed identity. The authorization server **40** preferably filters out unacceptable messages. Unacceptable messages can include those carrying a claimed identity that does not agree (on any predetermined statistical basis) with any records available at the authentication center **24**. In this case, unacceptable messages, for example, can include those (i) associated (e.g., by user name or id) with individuals who are not enrolled with the center **24** or (ii) associated (e.g., by the URL or a network location) with Web client stations **14** that are not registered with the center **24**.

The authorization server **40** preferably decrypts acceptable messages and passes them to a biometric server **42**. (However, it is to be recognized that the messages can be passed to the biometric server **42** without first being decrypted, in which case the biometric server **42** performs the decryption.) The messages are passed to the biometric servers **42** via element connectors **46**, i.e., using a channel supporting SSL or some other security protocol. The biometric server **42** of each passed message can be determined by various factors, including (i) the server **42** has enrolled the claimed identity of the individual seeking authentication, and (ii) the server has associated with it the Web server station **20** of which access is being sought, which data is preferably transmitted to the center **24** with the biometric data. Accordingly, the authorization server **40** preferably supports enrollment of an individual with respect to plural Web server stations **20**, each of which stations, for example, is in a captive structure with the authentication center **24**, i.e., has control of a captive biometric database **44** that includes records associated with the individual. The authorization server **40** preferably also supports enrollments associated with entirely independent structures, as well as with combinations of both configurations.

In configurations using passwords, the biometric server **42** preferably determines whether the transmitted password matches the password of record. The biometric server **42** can obtain the passwords of record in various ways. In a captive structure, the authentication center **24** has access to the applicable databases of the entity operating the Web server station **20**, including the databases **44** that maintain passwords. Accordingly, as non-biometric passwords are added, dropped, or changed in the captive case, the authentication center **24** has automatic access to the new passwords. In an independent structure, the authentication center **24** generally is without access to the passwords of the Web server station's database. Accordingly, the center **24** generally either/both maintains a password file (e.g., from enrollment) or obtains the password, in encrypted form, from the Web server station **20** to match against that submitted for authentication.

The biometric server **42** preferably processes the biometric data, including (i) to extract unique features of the biometric data, (ii) to enhance distinguishing aspects, and/or (iii) to compress the data. For example, with finger prints, the server **42** preferably extracts the minutiae of the scanned fingerprint image for comparison to similar features extracted during each individual's enrollment. It is to be

recognized, however, that this extraction may be omitted with respect to one or more types of biometric data, including fingerprint data, without departing from the principles of the invention.

The biometric server **42** compares the biometric data of each passed message with the records stored in the server's associated biometric databases **44**. To verify the individual's claimed identity, the biometric server **42** typically compares the biometric data to the records of the enrolled individual whose associated identity agrees with the claimed identity of the passed message. (Herein, "agrees with" means "is equivalent to within a predefined statistical level of confidence.")

Rather than verification, the comparison can be to identify the individual. To perform identification, the biometric servers **42** typically compare the live data to all records in their associated biometric databases **44**, so as to determine if there is a sufficient match. If such match is found, the center **24** returns the identity (or identities) associated with the matching record(s). It is to be understood that, unless the context militates otherwise, the description herein of the verification mode embraces both verification and identification, and all without departing from the principles of the invention.

The biometric server **42** can obtain access to biometric records in various ways. In a captive structure, the authentication center **24** has access to the applicable databases of the entity operating the Web server station **20**, including the biometric databases **44**. Accordingly, whether biometric records are added, dropped, or changed in the captive case, the authentication center **24** has automatic access to them. In an independent structure, the authentication center **24** generally is without access to the Web server station's database. Accordingly, the center **24** generally creates and maintains its own biometric databases, via enrollment of individuals.

An individual's live data typically fails to match exactly the individual's records. This occurs because acquisition of biometric data is subject to variations, both in the enrollment mode and in verification mode. Accordingly, the biometric servers **42** preferably employ comparison algorithms that do not require exact matches between the live data and records. Instead, the comparison algorithms generally are implemented to determine the statistical closeness of the live data to the records. In that implementation, the biometric servers **42** produce an affirmative response in the event of a sufficient match, i.e., if the closeness determination yields a result that falls into a selected range of confidence determined to be acceptable. On the other hand, the biometric servers **42** produce a negative response if the result falls into a selected range of confidence determined to be unacceptable. The biometric servers **42** preferably also support an indeterminate response (e.g., try again/provide more data) if the above ranges are not complementary and the result falls between such ranges. The indeterminate response can also result for other reasons, including that the authentication center **24** is at fault (e.g., is down, busy or otherwise).

The ranges may be selected under one or more criteria, and the criteria may vary among biometric characteristics. For example, one or more ranges may be selected solely to conform to statistical data, such as studies. In addition, one or more ranges may be selected by the administrator of the system **10**, or by the administrator of the Web server station **20**, or by a combination of either or both, with or without statistical data. In any case, optimum selections are generally selected to strike a selected balance between false positives and false negatives.

Following each authentication, the authentication center **24** produces a response. The center **24** provides the response, whatever its nature, to either/both the Web server station **20** and the Web client station **14**, the routing of the response depending on the configuration of the system **10**. In the case of a negative response, the center **24** preferably provides the response only to the Web client station **14**. In that case, however, the authentication center **24** preferably records the details of the authentication process so as to create a biometric audit trail, as described below.

The center **24** can download a response to the Web client station **14** and to the Web server station **20** in various ways. As an example, the center **24** can prepare and download to either or both stations **14**, **20** a message that comprises a selected representation of the result of the comparison (e.g., pass, fail, confidence level, etc.), the message being suitable for downloading via the secure transport protocol or protocols in place between the center **24** and respective stations. As another example, to do so respecting the Web client station **14**, the authentication center **24** can download a page having electronic links that provide access to one or more of the application servers **32** of the Web server station **20**, which access generally is subject to the individual's authorization at such station **20** and/or with each such server **32**. In such case, the authentication server **24** includes a Web server **48** so as to support the Web protocols, e.g., HTTP/HTML. Also in such case, the page can include or activate only those electronic links that are appropriate to the confidence level attained in the authentication, i.e., levels of access can be supported. As yet another example, to respond to the Web server station **20**, the authentication center **24** can, in a captive structure, make an appropriate entry (e.g., set a flag and/or provide other data to distinguish the authentication for the particular session) in the biometric database **44**.

In another case, the center **24** can download the response to the Web client station **14** while routing the response to the Web server station **20** via the Web client station **14**, without departing from the principles of the invention. To do so, the authentication center **24** can send to the station **14** a digital certificate, which certificate the center **24** encrypts with data that distinguishes the authentication for the particular for the particular client and server stations of the instant session and which certificate the center **24** preferably generates in accordance with principles understood in the art.

Turning to FIG. **5**, a flow chart is shown that depicts the operation of the biometric authentication system **10**, according to the present invention. In step **100**, the Web client station **14** requests access of a Web server station **20**. The station **14** typically does so by entering the Web location of the Web server station **20**, such location being in the form of a Uniform Resource Locator ("URL"). In this step, a secure communication channel is established between the Web client and server stations, via the Web cloud **12**. For example, if SSL is employed, the secure communication channel is established during the SSL handshake, including by, among other things, (i) negotiating an encryption algorithm between the stations **14**, **20** via the Web cloud **12** and (ii) authenticating the Web server station **20** to the Web client station **14**.

In step **102**, parameters are established at the Web client station **14**. The parameters are associated with the biometric data to be used in authenticating the individual seeking access of the particular Web server station **20**. As previously described, the parameters preferably are provided to the Web client station **14** from the Web server station **20** by downloading a page from station **20** using HTTP over SSL. However, it is to be recognized that the parameters can be established otherwise, without departing from the principles of the invention.

In step **104**, the biometric I/O devices **16** associated with the parameters acquire the individual's biometric data. The acquisition is controlled by the biometric I/O mechanism **28**.

In step **106**, which may occur prior or subsequent to, or simultaneous with, step **104**, the individual enters a password. The password can be entered using either a non-biometric I/O device **18** (e.g., a keyboard or a voice-recognition microphone) or a biometric I/O device **16** (e.g., a microphone acquiring voice prints). In the latter case, the password preferably is integral to the biometric data. The password can be predetermined or volatile, volatile passwords being associated with only the instant session, without departing from the principles of the invention. In the case of volatile passwords, they preferably are generated by the Web server station **20** and provided (i) to the Web client station **14** in the download and (ii) to the authentication center **24** either via the Web client station **14** (forwarded in encrypted form) or via download or, if a captive structure, by placement in the biometric database **44** maintained by the station **20**.

In step **107**, the Web client station **14** provides for the individual's claimed identity. As previously stated, the claimed identity can be indicated by the individual's user name or user id, by the Web location of the individual's Web client station **14**, or by other identification token or by combination.

In step **108**, encryption is performed. Preferably, both the password and the biometric data, or data representative thereof, are encrypted.

In step **110**, a message is received at an authentication center **24**. The message preferably is received via one or more secure communication channels, e.g., a channel supporting SSL or some other security protocol. Furthermore, the message preferably is downloaded to the center **24**, bypassing the Web server station **20**. However, the message can be routed to the center **24** via the Web server station **20**, without departing from the principles of the invention.

In step **112**, the authentication center **24** filters out unacceptable messages. Unacceptable messages are described above. If a message is filtered out, the center **24** preferably sends a predetermined reject message to the Web client station **14**, as shown by step **113**. Although it is not shown, a reject message can also be sent to the Web server station **20**, without departing from the principles of the invention.

In step **114**, the authentication center **24** decrypts acceptable messages. This decrypting action is to recover the biometric data and, if used, the password.

In step **116**, the live data (e.g., the acquired biometric data or data representative thereof, wherever such representative data is obtained by processing acquired biometric data) is compared to selected records of the enrolled individual whose associated identity agrees with the claimed identity of the message. Prior to the comparison, the live data preferably is passed by the authorization server **40** to an appropriate biometric server **42**.

Step **116** can also include comparison of the received password to the password associated with the enrolled individual whose identity agrees with the claimed identity.

As previously discussed, the system **10** contemplates an authentication center **24** supporting more than one biometric server **42**. In turn, the method for using the system **10** contemplates using said support to advantage. For example, as previously described with reference to FIG. **4**, each biometric server **42** can be used to authenticate in relation to a respective one of the Web server stations **20**. As another example, however, a plurality of biometric servers **42** can be used to authenticate in relation to a single Web server station **20**. In that latter example, the biometric servers **42** can be organized to authenticate in parallel, serially or in combinations of both. The parallel authentication can be implemented for various purposes, including (i) for redundancy, (ii) to employ various tests or comparison algorithms to one biometric data type or (iii) to employ respective comparison algorithms to various biometric data types. The serial authentication can be implemented for various purposes, including to create a series of hurdles erected to provide levels of access or merely to establish a concatenated authentication.

In step **118**, based on the result of the comparison, the authentication center **24** provides a response, after which the authentication process preferably terminates. Although termination is preferred, it is contemplated that, under predetermined circumstances, additional authentication processing may be initiated, without departing from the principles of the invention. As an example, if the receipt of data is flawed or the center **24** experiences a problem, the center **24** can be configured to initiate additional biometric processing, e.g., by sending a page from the Web server **48** to the Web client station **14**, the page suggesting additional or substitute data, with or without notification to the Web server station **20**. As another example, in the event of positive verification of identity such that access is granted and a session is being conducted, the system **10** can be configured to initiate additional biometric processing in the form of continuous, regular or random re-authentications during the session. In such case, typing pattern or finger print data can be acquired in the background (software monitors keystrokes or keyboards have scanners) and transmitted to the center **24** for authentication. Re-authentications combat against crackers taking advantage of a Web client station **14** left unattended during a session by an authenticated individual.

Moreover, additional processing is contemplated in response to negative verification of identity. In that regard, step **120** provides that the authentication center **24** records the details of the authentication process. These details included one or more of the time, the date, all or selected biometric data, the password, the Web client station **14** and the Web server station **20**. These records create a biometric audit trail so as to discourage repeated attempts of illegitimate individuals and to enhance opportunities to capture crackers. Indeed, the authentication system can be used, following failed verification or otherwise, to perform an identification process, wherein records of all enrolled individuals are compared to the live data of the failed authentication. This effort preferably can be extended to similar centers and can be part of the enrollment process. If the purpose is to identify crackers and one is so identified, the cracker can more readily be prosecuted, if merited, or otherwise stripped of power to impact the Web server stations **20**, other Web entities, or this system **10**.

The steps described above can be configured to support various options, without departing from the principles of the invention. For example, to authenticate based on voice prints, the steps can be configured so that the individual speaks a password, e.g., a multi-digit word or phrase, which password is isolated from the voice print at the authentication center **24** for comparison to a predetermined password. Accordingly, both the password and the voiceprint must sufficiently match for an affirmative authentication.

As another example, data of plural biometric characteristics can be combined to increase overall confidence in the authentication. Although combination is generally subject to cost/benefit trade-offs, entities offering Web information, services and other resources, including transactions, can be

expected to set their own security demands. In such case, the level of security associated with each biometric characteristic alone preferably is categorized. Similarly, the overall levels of security associated with combinations of characteristics preferably are categorized. These data points typically would be available to each Web server station **20** in configuring their usage of the Web-based biometric authentication system.

In another configuration example, the system **10** can be used with or without passwords. To illustrate, an emergency room clinician can scan the fingerprint of an unconscious patient not only to gain access to the patient's records, but also perhaps to identify the individual. In either case, a password is both unnecessary and undesirable, while authentication both protects the records, guards patients' privacy and allows vital care to be performed appropriate to the individual.

Parameters.

The content of the parameters varies according to the configuration of the system. That is, parameters vary according to whether the system is entirely captive (i.e., the authentication center is operated by the same entity that operates the Web server station **20**), partially captive (e.g., the entity operating the Web server station **20** as a whole, or one or more application servers **32**, makes its biometric databases **44** available to the separately operated authentication center **24**, which is also operating the Web server **30** of the Web server station **20**) or independent (e.g., the authentication center **24** enrolls individuals and provides an authentication service respecting its enrolled individuals to those entities operating one or more Web server stations **20**).

Examples of parameters that can be used, include: (i) one or more specific biometric characteristics for use in authentication, with or without alternatives; (ii) a number of biometric characteristics to be used, without specifics as to which types can be used; (iii) criteria for authentication, including both selection among comparison algorithms and the confidence range or ranges for determining whether a sufficient match is obtained; (iv) how responses are to be routed to the station **20**, including whether and, if so, what form of digital certificate is acceptable; (v) how biometric data is to be routed to the authentication center **24**; (vi) which authentication center **24** is to be used or, assuming the individual is enrolled at more than one center, from which centers the applicable center is to be selected or the criteria for selection (e.g., "XXX"-certified centers); (vii) whether and, if so, which parameters can be modified and the mechanism for doing so; (viii) whether and, if so, what further processing can be performed after an individual is not authenticated, and (ix) data specific to the endeavors conducted by the entity operating the Web server station, e.g., bank account number, patient number, employee number, etc. While one or more of the above parameters can be used, other or additional parameters can be used, without departing from the principles of the invention.

As previously described, parameters preferably are included in a download of a page from the Web server station **20**, e.g., the station's home page as encountered by the Web client station **14** when initially seeking access. Indeed, the downloaded page can include parameters that offer alternatives that are selectable. The selection can be made at the individual's volition (e.g., the biometric characteristic or combinations that are acceptable to the individual), automatically by the Web client station **14** (e.g., based on supported biometric characteristics), by the authentication center **24** (i.e., the Web client station **14** forwards the alternatives to the center **24**), or by combinations of these or otherwise.

However, some or all of the parameters can be established otherwise, without departing from the principles of the invention. For example, after the first downloaded page, parameters can be communicated from the Web server station **20** in one or more subsequently downloaded pages from the Web server station **20**. These parameters can be supplementary, substitutional or negotiable in nature. As a further example, some or all of the parameters either can be communicated from the authentication center **24** or can be communicated from within the Web client station **14** to itself ("local availability"). Moreover, the parameters can be established through communications involving any combination of these sources, without departing from the principles of the invention.

Local availability at the Web client station **14** can be used, for example, where the parameters are unchanging or where received parameters are incompatible with that station **14**. One form of local availability is storage. Storage is initiated by the individual, or is performed automatically at the Web client station **14** in response to the station's detection of a selected trigger, e.g., a certain total number of access attempts or an access frequency threshold. The automatic storage, if supported, preferably is controlled by the interface mechanism **28**. Another form of local availability is to enable the station **14** to make selections from alternatives (see above) or to enable the station **14** to be responsive to incompatibility. For example, if biometric data associated with received parameters cannot be provided by the Web client station **14** (which can be an issue particularly in independent structures), the mechanism **28** preferably is enabled either/both to (i) request permission to send alternative biometric data (e.g., based on the Web client station's capabilities) or (ii) obtain and transmit other biometric data of its own selection.

Communication of parameters from the authentication center **24** can be in place of communication from the Web server station **20** and the Web client station **14**. In addition, communication from the center **24** can supplement the communication(s) from the stations **20**, **14**, as well as other communication from the center **24** itself. Communications from the center **24** can also be negotiable with other communications.

Supplementary communication, from whatever source, can be used, for example, where the existing parameters can be incompatible with the Web client station **14**. That incompatibility, which can be an issue particularly in independent structures, can arise due to various factors, including, without exhaustion: (i) a biometric I/O device **16** associated with a parameter is absent or, if present, is not functional; (ii) the interface mechanism **28** fails to support a biometric I/O device **16** associated with a parameter; (iii) the individual is unable to provide biometric data associated with a parameter; and (iv) the individual is unwilling to provide certain biometric data as a matter of principle, e.g., that data violates privacy or religious issues.

Supplementary transmission, from whatever source, can be used, in another example, where the existing parameters can be incompatible with the authentication center **24**. That incompatibility, which can be an issue particularly in independent structures, can arise due to various factors, including, without exhaustion: (i) the authentication station **24** does not support authentication based on biometric data associated with one or more existing parameters, e.g., the individual did not provide such data when enrolling with the center **24**; (ii) the center suffers a complete or partial failure of elements respecting biometric data associated with one or more of the existing parameters; and (iii) the individual's

identity cannot be verified to obtain a sufficient match using the biometric data of the existing parameters, but the system **10** is configured, at least with respect to the instant Web server station **20**, to allow opportunity to authenticate using additional or different biometric data.

As described above, it will be apparent to one skilled in the art that the invention contemplates establishing parameters using various communications and methods. As to the Web client station **14**, the methods include (i) local availability, with or without parameters from the Web server station **20** or the authentication center **24**, or (ii) single or plural downloads to the Web client station **14** from either or both the Web server station **20** or the authentication center **24**, with or without locally-provided parameters, or (iii) communication of parameters (supplementary, substitutional or negotiable) involving any combination of the Web client station **14**, the Web server station **20** and the authentication station **24**, using arbitration algorithms as appropriate.

As to the authentication center **24**, parameters typically focus on what data is to be analyzed, the criteria for authentication, including the algorithms to be used and the confidence range or ranges for determining whether there is a sufficient match, and where and how response data is to be routed, including whether and, if so, what form of digital certificates are acceptable. In any particular configuration, one or more of these matters can be fixed, i.e., the parameters are established locally. For example, the center **24** may support only two types of data, with one algorithm for each. However, these and other matters can be selectable, in which case the selectable parameters are preferably established by the Web server station **20** in accordance with its security needs. In any case, any parameters selected preferably are transmitted to the center **24** with the biometric data. It is to be recognized, however, that such parameters can be otherwise directed to the center **24**: for example, the Web server station **20** can download parameters to the center **24** (e.g., a multicast of the page containing the parameters) or, in a captive structure, can make the parameters available via the biometric database **44**.

Except for the case of establishing parameters from a single source in a single transmission, the system **10** preferably provides for arbitration among the Web client station **14**, the Web server station **20** and the authentication center **24** so as to finally establish the parameters to be used in the authentication.

Authentication Center.

The biometric data originates at the Web client station **14** and is received at the authentication center **24** for analysis. Preferably the data is downloaded from the station **14** to the authentication center **24**, bypassing the Web server station **20**. However, the data can be routed from the station **14** to the center **24** via the Web server station **20**, without departing from the principles of the invention.

Particularly in an independent structure, plural authentication centers **24** can be available, such that a determination is to be made of the particular authentication center that will perform the authentication steps associated therewith. The determination responds to various issues, including: (i) with which center or centers **24** the individual and/or client station **14** is enrolled; (ii) if enrolled at plural centers **24**, what biometric data is stored in records of each center; and (iii) what center or centers, or types of centers, does the Web server station **20** accept, e.g., it is registered with one or more centers or it requires certain algorithms, certifications or services.

In the wholly captive structure, the authentication center is determined by the structure. In effect, it is a matter of predetermination: e.g., the bank operates the Web server station **20** for its customers who are the individuals operating the Web client stations **14**, the customers having registered with the captive authentication center **24** when opening their respective bank accounts.

In the independent structure, the authentication center **24** preferably is determined by either or both the Web client station and the Web server station. Typically, this is on a per access request basis.

This determination preferably is by the Web client station **14**. This is preferred because (i) the station **14** has its associated enrollment data and (ii) the station **14** preferably downloads live data to the center **24**, by-passing the Web server station **20** This determination can be made with or without input from the Web server station **20**. For example, the station **14** can identify the center **24** to the station **20** for approval. If the Web server station **20** finds the so identified center **24** unacceptable, the station **20** can request a re-determination, e.g., that some other center **24** be used.

If the Web client station **14** determines, it preferably sends the Web server station's identification to the center **24**, if the center **24** is to download a response directly to the Web server station **20**. The identification of the Web server station **20** can also be to enable the center **24** to authenticate in accordance with the Web server station's selected criteria, assuming that the criteria are stored at the center **24** (e.g., the station **20** subscribes for the service, providing such criteria). If the center **24** is configured to support generation of digital certificates, the identification of the server station **20**, as well as other data (e.g., the parameters) can also be to allow encryption of that data within the certificate.

Independent structure also can support the Web server station **20** determining a particular authentication center **24**. In that case, if the Web client station **14** is to download the biometric data directly to the authentication center **24**, the Web server station **20** preferably includes the center's identification as a parameter provided to the Web client station **14**, e.g., in the download of a page to the Web client station **14**. However, if the Web client station **14** is to route the biometric data to the authentication center **24** via the Web server station **20**, the station **20** preferably selects the center **24** when transmitting the biometric data to that center and no such parameter need be provided to the station **14**. In cases of such routing and center **24**, the biometric data from the Web client station **14** preferably is accompanied by identification of the authentication center or centers **24** at which the individual is enrolled, simply because the individual typically is enrolled at limited numbers of centers **24**.

The systems methods according to this invention, including the described embodiments, provide various advantages. Some of the advantages include, for example: biometric data is logically available at a central location—the authentication center **24**—for authenticating individuals within the context of their Web-based transactions; authentication is generally rapid, reliable and secure; except for nominal interaction with biometric I/O devices **16**, the authentication is generally transparent to the individual; the system is relatively cost effective, especially compared to systems using custom hardware and software solutions; the authentication is highly scalable and yet, by definition, personal; and the authentication benefits from flexibility, both (i) in terms of providing various levels of confidence available to and selectable by each entity requiring authentication and (ii) in terms of providing alternative biometric characteristics for selection by each individual, responsive to the individual's (or, as the case may be, their Web client station's) abilities, impairments and principles.

While the invention has been described in connection with preferred embodiments, it will be understood that modifications thereof within the principles outlined above will be evident to those skilled in the art and thus the invention is not limited to the preferred embodiments but is intended to encompass such modifications.

What is claimed is:

1. A method for Web-based, biometric authentication of individuals who are using a Web Client station, the individuals seeking access of a Web server station, the method comprising the steps of:

establishing parameters associated with selected biometric characteristics to be used in authentication;

acquiring, at the Web client station, biometric data from an individual in accordance with the parameters;

receiving, at an authentication center, a message that includes live data comprising the acquired biometric data from the individual seeking access of the Web server station;

selecting, at the authentication center, one or more records from among records associated with one or more enrolled individuals;

comparing the live data with selected records, the comparison determining whether the so-compared live data sufficiently matches the selected records as to authenticate the individual seeking access;

recording selected details of the received message and the results of the comparing step so as to create a biometric audit trail; and

when an individual fails authentication, using selected details of the received message, and comparing said selected details with a plurality of records, the comparison determining whether the so-compared selected details sufficiently match any one or more of the so-compared records, so as to identify the individual seeking unauthorized access of the Web server station.

2. A method as claimed in claim 1, wherein said step of comparing said selected details with a plurality of records where an individual fails authentication comprises using, as the plurality of records, biometric data records of said authentication center and also biometric data records of at least one additional authentication center.

3. A method as claimed in claim 1, wherein said live data includes a voice print and the selected records include voice print data.

4. A method as claimed in claim 1, further comprising the steps of:

providing, at the Web client station, a claimed identity associated with the individual;

receiving, at the authentication center, a message that includes the claimed identity;

determining the acceptability of the message based on the claimed identity;

if the message is acceptable, providing, at the authentication center, selected records that agree with the claimed identity; and

comparing the received data with the so-provided, selected records.

5. A method as claimed in claim 1, further comprising the step of providing, from the authentication center, a response respecting the result of the comparing step, this providing step comprising the steps of:

(A) preparing the response, which step includes one or more of the following steps:

(i) preparing a digital certificate;

(ii) preparing a page having electronic links to accessible pages associated with one or more application servers;

(iii) preparing an appropriate entry in a biometric database; and

(iv) preparing a secure protocol message; and

(B) effecting the response, which step includes one or more of the following steps:

(i) downloading the response to the Web server station;

(ii) routing the response to the Web server station via the Web client station;

(iii) making an appropriate entry in a selected biometric;

(iv) downloading the response to the Web client station; and

(v) routing the response to the Web client station via the Web server station.

6. A method as claimed in claim 5, wherein the step of preparing a page having electronic links comprises including or activating only those electronic links that are appropriate to the confidence level attained in the comparing step.

7. A method as claimed in claim 1, further comprising the step of establishing secure communication channels in and among the Web client station, the Web server station and the authentication station.

8. A method as claimed in claim 7, wherein the step of establishing secure communication channels comprises:

(A) employing a Web client at the Web client station and a Web server at the Web server station, the Web client and the Web server providing for establishing a secure communication channel between the Web client station and the Web server station; and

(B) employing an interface mechanism at the Web client station and an authorization server at the authentication center, the interface mechanism and the authorization server providing for establishing a secure communication channel between the Web client station and the authentication center.

9. A method as claimed in claim 1, wherein:

the acquiring step comprises plural acquisitions, said plural acquisitions relating to one or more biometric characteristics; and

the establishing parameters step further comprises at least one of the following steps:

(i) selecting a confidence level from among supported confidence levels, said supported confidence levels being categorized in relation to authentication based on using biometric data associated with single biometric characteristics and with combinations of biometric characteristics; and

(ii) selecting a trigger event, said trigger event causing the acquisition of biometric data.

10. A method as claimed in claim 9, wherein the step of selecting a trigger event comprises selected a time interval for repeating the authentication steps.

11. A method as claimed in claim 1, wherein the step of establishing parameters comprises one or more communications by and among the Web server station, the Web client station and the authentication center.

12. A method as claimed in claim 11, wherein the step of establishing parameters further comprises the step of choosing among negotiable parameters by using predetermined arbitration algorithms.

13. A method as claimed in claim 11, wherein the step of establishing parameters further comprises downloading a page from the Web server station to the Web client station responsive to the Web client station requesting access of the Web server station, the page including parameters.

14. A method as claimed in claim 1, further comprising the step of determining an authentication center from among plural authentication centers.

* * * * *