

METHODS AND SYSTEMS FOR TRUSTED WEB AUTHENTICATION

TECHNICAL FIELD

The presently disclosed subject matter relates to methods and systems for enabling trusted authentication, in particular to cloud-based services and/or websites.

BACKGROUND

In the web, users need to be authenticated when attempting to access various cloud-based services and/or websites, such as emailing websites, bank accounts, health records, etc.

Most websites still use a username and password to authenticate users. Some websites use physical devices or two-factor authentication (using token and/or mobile phones).

Each method has disadvantages: passwords can be stolen, physical devices are not convenient, and two-factor authentication does not prevent the creation of fake identities, since a one-time SIM card can be used.

Another issue is that one (physical) person may have many unrelated (virtual) identities: several email addresses (private and business), phone numbers and profiles in different social networks. It may also be legitimate to use multiple profiles for business purposes, advertisement and promotional activities. The problem is that illegal activists abuse the web openness and create fake identities to hide their activities.

There is now a need to provide new methods and systems for enabling trusted authentication, in particular to cloud-based services and/or websites.

GENERAL DESCRIPTION

In accordance with certain aspects of the presently disclosed subject matter, there is provided an identification method, comprising:

providing at least one database storing, for each of a plurality of users, user data comprising:

- o biometric data representative of biometric features of the user,

- user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website, the method comprising, by at least one processing unit:
- obtaining biometric data representative of biometric features of a candidate user attempting to be identified by a given website,
- searching, in the database, biometric data matching the biometric data of the candidate user according to a matching criterion, and
- sending to the given website at least a password stored for the candidate user in the database and associated with the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website.

In addition to the above features, the method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (i) to (x) below, in any technically possible combination or permutation:

- i. for each user, a password associated with a given website is stored in an encrypted form in the database using a public key of the given website, wherein the password can be decrypted using a private key available only to the given website;
- ii. the method comprises sending at least a password stored for the candidate user in the database and associated with a username for which the user is attempting to be identified by the website;
- iii. the method comprises based on biometric data representative of biometric features of the candidate user, searching, in the database, biometric data matching the biometric data of the candidate user according to a matching criterion, determining a plurality of usernames of the candidate user for the given website, based on an input of the candidate user indicating a given username among said plurality of usernames, sending, to the given website, the given username and at least a password stored for the candidate user in the database and associated with the given username for the given website;
- iv. the method comprises decrypting the password of the candidate user by the given website, and authorizing access to the given website by the candidate user based at least on a username of the user and the decrypted password;

- v. the database stores, for at least one user, user data comprising, for a given username of the user, a plurality of passwords for a given website, wherein the method comprises sending to the given website a password which is the most recent one created in the database among the plurality of passwords stored for the candidate user in the database and associated with the given username for the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website;
- vi. the database is a decentralized ledger database;
- vii. the database is a distributed database comprising a plurality of elementary databases, wherein each of the elementary databases stores the same data, and wherein adding a new record in one of the elementary databases, propagates in all other elementary databases;
- viii. the database stores, for each of a plurality of users, a plurality of distinct records, each record comprising biometric data representative of biometric features of the user, and at least one username and associated password for a given website.
- ix. when the user changes from the password to a new password associated with the username and the given website, the method comprises creating a new record in the database comprising biometric data representative of biometric features of the user, and the username and associated new password for the given website, wherein an indication that the new password has been created after the old password, is present in the database; and
- x. the biometric data is stored using a unique mathematical representation in the database.

According to another aspect of the presently disclosed subject matter there is provided a method, comprising, by at least one processing unit:

- obtaining biometric data representative of biometric features of a candidate user attempting to be registered in a given website,
- obtaining a username and password provided by the candidate user for the given website,
- encrypting the password using a public key specific to the given website,

- storing, in at least one database, user data for said candidate user, the user data comprising said biometric data, said username, and at least said password associated with said username for said given website, wherein the database is searchable for providing, upon request, for said username of said given website, said password in an encrypted form based on said biometric data, wherein the password can be decrypted by a private key available only to the given website.

In addition to the above features, the method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (ii) to (x) above, in any technically possible combination or permutation.

According to another aspect of the presently disclosed subject matter there is provided a method comprising, by at least one processing unit:

- upon attempt of a candidate user to be identified by a given website based at least on biometric data of the candidate user, obtaining a password of the candidate user for this given website extracted from a database storing, for each of a plurality of users, user data comprising:
 - o biometric data representative of biometric features of the user,
 - o user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website, and
- decrypting the password of the candidate user by the given website, and
- authorizing access to the given website by the candidate user based at least on the decrypted password.

In addition to the above features, the method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (ii) to (x) above, in any technically possible combination or permutation.

According to another aspect of the presently disclosed subject matter there is provided a system configured to, by at least one processing unit:

- obtain biometric data representative of biometric features of a candidate user attempting to be identified by a given website,
- search, in at least one database, biometric data matching the biometric data of the candidate user according to a matching criterion,

wherein the at least one database stores, for each of a plurality of users, user data comprising:

- biometric data representative of biometric features of the user,
- user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website, and
- sending to the given website at least a password stored for the candidate user in the database and associated with the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website.

In addition to the above features, the system according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (xi) to (xx) below, in any technically possible combination or permutation.

- xi. for each user, a password associated with a given website is stored in an encrypted form in the database using a public key of the given website, wherein the password can be decrypted using a private key available only to the given website;
- xii. the system is configured to send at least a password stored for the candidate user in the database and associated with a username for which the user is attempting to be identified by the website;
- xiii. the system is configured to, based on biometric data representative of biometric features of the candidate user, search, in the database, biometric data matching the biometric data of the candidate user according to a matching criterion, determine a plurality of usernames of the candidate user for the given website, based on an input of the candidate user indicating a given username among said plurality of usernames, send, to the given website, the given username and at least a password stored for the candidate user in the database and associated with the given username for the given website;
- xiv. the system is configured to decrypt the password of the candidate user by the given website, and authorize access to the given website by the candidate user based at least on a username of the user and the decrypted password;
- xv. the database stores, for at least one user, user data comprising, for a given username of the user, a plurality of passwords for a given website, the

system being configured to send to the given website a password which is the most recent one created in the database among the plurality of passwords stored for the candidate user in the database and associated with the given username for the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website;

- xvi. the database is a decentralized ledger database;
- xvii. the database is a distributed database comprising a plurality of elementary databases, wherein each of the elementary databases stores the same data, and wherein adding a new record in one of the elementary databases propagates in all other elementary databases;
- xviii. the database stores, for each of a plurality of users, a plurality of distinct records, each record comprising biometric data representative of biometric features of the user, and at least one username and associated password for a given website;
- xix. when the user changes from the password to a new password associated with the username and the given website, the system is configured to create a new record in the database comprising biometric data representative of biometric features of the user, and the username and associated new password for the given website; and
- xx. the biometric data is stored using a unique mathematical representation in the database.

According to another aspect of the presently disclosed subject matter there is provided a system configured to, by at least one processing unit:

- obtain biometric data representative of biometric features of a candidate user attempting to be registered in a given website,
- obtain a username and password provided by the candidate user for the given website,
- encrypt the password using a public key specific to the given website,
- store, in at least one database, user data for said candidate user, the user data comprising said biometric data, said username, and at least said password associated with said username for said given website,

wherein the database is searchable for providing, upon request, for said username of said given website, said password in an encrypted form based on said biometric data,

wherein the password can be decrypted by a private key available only to the given website.

In addition to the above features, the system according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (xi) to (xx) above, in any technically possible combination or permutation.

According to another aspect of the presently disclosed subject matter there is provided a system configured to, by at least one processing unit:

- upon attempt of a candidate user to be identified by a given website based at least on biometric data of the candidate user, obtain a password of the candidate user for this given website extracted from a database storing, for each of a plurality of users, user data comprising:
 - o biometric data representative of biometric features of the user,
 - o user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website,

wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website,

- decrypt the password of the candidate user by the given website, and
- authorize access to the given website by the candidate user based at least on the decrypted password.

In addition to the above features, the system according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (xi) to (xx) below, in any technically possible combination or permutation.

According to another aspect of the presently disclosed subject matter there is provided a non-transitory storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform a method comprising:

- obtaining biometric data representative of biometric features of a candidate user attempting to be identified by a given website,
- searching, in at least one database, biometric data matching the biometric data of the candidate user according to a matching criterion,

wherein the at least one database stores, for each of a plurality of users, user data comprising:

- o biometric data representative of biometric features of the user,

- user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website, and
- sending to the given website at least a password stored for the candidate user in the database and associated with the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website.

In addition to the above features, the executed method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (i) to (x) above, in any technically possible combination or permutation.

According to another aspect of the presently disclosed subject matter there is provided a non-transitory storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform a method comprising:

- obtaining biometric data representative of biometric features of a candidate user attempting to be registered in a given website,
- obtaining a username and password provided by the candidate user for the given website,
- encrypting the password using a public key specific to the given website,
- storing, in at least one database, user data for said candidate user, the user data comprising said biometric data, said username, at least said password associated with said username for said given website,

wherein the database is searchable for providing, upon request, for said username of said given website, said password in an encrypted form based on said biometric data,

wherein the password can be decrypted by a private key available only to the given website.

In addition to the above features, the executed method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (i) to (x) above, in any technically possible combination or permutation.

According to another aspect of the presently disclosed subject matter there is provided a non-transitory storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform a method comprising:

- upon attempt of a candidate user to be identified by a given website based at least on biometric data of the candidate user, obtaining a password of the candidate user

for this given website extracted from a database storing, for each of a plurality of users, user data comprising biometric data representative of biometric features of the user, user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website,

- decrypting the password of the candidate user by the given website, and
- authorizing access to the given website by the candidate user based at least on the decrypted password.

In addition to the above features, the executed method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (i) to (x) above, in any technically possible combination or permutation.

According to some embodiments, the proposed solution provides a trusted authentication for accessing websites, thereby improving security, robustness, and protection of data and life privacy.

According to some embodiments, the proposed solution allows a user to create strong passwords for a plurality of websites, without requiring from the user to remember these passwords.

According to some embodiments, the proposed solution reduces the risk of fraud and forgery in user authentication.

According to some embodiments, the proposed solution reduces the risk of password theft and/or cracking by a third party.

According to some embodiments, the proposed solution prevents creation of multiple fake identifies by a user.

According to some embodiments, the proposed solution improves both security and flexibility of user authentication.

According to some embodiments, the proposed solution adapts to existing websites which propose traditional authentication based on username and password, and proposes an alternative trusted authentication compatible with this traditional authentication.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it can be carried out in practice, embodiments will be described, by way of non-limiting examples, with reference to the accompanying drawings, in which:

- **Fig. 1** illustrates a system which can be used to perform one or more methods described hereinafter;
- **Fig. 1A** illustrates data of users that can be stored in a database;
- **Fig. 2** illustrates a registration method of a user based on biometric data;
- **Fig. 3** illustrates an example of an interface of a website;
- **Fig. 4** illustrates a method of handling the update of a password of a user for a website;
- **Fig. 5** illustrates an embodiment of a method of authenticating a user based on biometric data provided by the user, and authorizing access of the user to a website; and
- **Fig. 5A** illustrates another embodiment of a method of authenticating a user based on biometric data provided by the user, and authorizing access of the user to a website.

DETAILED DESCRIPTION

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the presently disclosed subject matter may be practiced without these specific details. In other instances, well-known methods have not been described in detail so as not to obscure the presently disclosed subject matter.

Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as "obtaining", "providing", "searching", "sending", "storing", "encrypting/decrypting", "authorizing" or the like, refer to the action(s) and/or process(es) of a processing unit that manipulates and/or transforms data into other data, said data represented as physical, such as electronic, quantities and/or said data representing the physical objects.

The term “processing unit” covers any computing unit or electronic unit with data processing circuitry that may perform tasks based on instructions stored in a memory, such as a computer, a server, a chip, a processor, a hardware processor, etc. It encompasses a single processor or multiple processors, which may be located in the same geographical zone or may, at least partially, be located in different zones and may be able to communicate together.

The term “memory” as used herein should be expansively construed to cover any volatile or non-volatile computer memory suitable to the presently disclosed subject matter.

Embodiments of the presently disclosed subject matter are not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the presently disclosed subject matter as described herein.

The invention contemplates a computer program being readable by a computer for executing one or more methods of the invention. The invention further contemplates a machine-readable memory tangibly embodying a program of instructions executable by the machine for executing one or more methods of the invention.

Fig. 1 illustrates a system **100**, which can be used to perform one or more methods described hereinafter.

As shown, at least one biometric identification device (or biometric sensor) **105** can be provided. The biometric identification device **105** can be used to collect, or to sense, from a user, biometric data, representative of biometric features of the user.

Non-limitative examples of a biometric identification device **105** include:

- Fingerprint sensor, configured to sense fingerprint(s) of the user;
- Facial scanning device, configured to provide a 2D or 3D representation of the user's face and/or body;
- Eyes sensing device;
- Iris sensing device;
- Camera; and
- Other devices.

The biometric identification device **105** is typically located on the side of the user. In some embodiments, the biometric identification device **105** is embedded in a portable device of the user, such as, but not limited to a cellphone or computer of the user.

As shown in **Fig. 1**, a user application is provided and can be executed on a processing unit **110**. The user application can provide an interface allowing a user to register his personal user data, and biometric data, as explained hereinafter.

As shown in **Fig. 1**, a database system **140** is provided, which is suitable for storing data representative of the users.

According to some embodiments, the database system **140** is a distributed database, which comprises a plurality of elementary databases **150**.

According to some embodiments, each of the elementary databases **150** stores the same data. According to some embodiments, a modification of the data (especially adding a new record) in one of the elementary databases, propagates in all other elementary databases.

According to some embodiments, the database system **140** is a decentralized ledger database.

According to some embodiments, each of the elementary databases **150** stores a plurality of blocks (created over time), wherein a hash of previous block N-1 is stored in current block N (and so forth). As a consequence, alteration of the data in the database is would be impractical.

According to some embodiments, the database system **140** can rely on blockchain technology to store data. This can include storing data using a plurality of blocks, wherein a hash of a previous block N-1 is stored in current block N, and so forth, thereby preventing corruption of data. In particular, data in any given block cannot be altered retroactively without alteration of all subsequent blocks, which requires authorization of the other databases, or authorization of all users of the databases.

In addition, according to some embodiments, no single centralized administration of the different databases **150** is used.

According to some embodiments, each of the elementary databases **150** does not allow modification of stored data, but only addition of new data.

As shown in **Fig. 1**, data can be exchanged using a network **120**, such as, but not limited to, the Internet.

Data can be exchanged between the user (e.g. user application/biometric identification device), the database system **140** and one or more websites **160** (websites include e.g. webpages, cloud based services, etc.).

Fig. 1A illustrates data that can be stored in the database system **140** (in particular, this data can be stored in each of the distributed databases **150** of the database system **140**).

The data can comprise biometric data **170**, stored for each of a plurality of users.

Biometric data can comprise e.g. data representative of the fingerprint, eyes, iris, face, body, iris, etc. of the user.

In some embodiments, biometric data is provided by the biometric identification device **105** (e.g. a picture, etc.) and is stored using a mathematical representation which is unique for each biometric data. For example, a hash can be used.

In some embodiments, for a given user, a plurality of biometric data can be stored.

According to some embodiments, for a given website, a plurality of different biometric data (iris, fingerprint, etc.) is stored for each user. The combination of different biometric data can differ between the websites.

According to some embodiments each website can rely on a different type of biometric identification, and therefore, for each user, a plurality of biometric data is stored (for example iris picture for website 1, picture for website 2, and fingerprint data for website 3, etc.).

According to some embodiments, the database system **140** can further store user identification data **180**. This user identification data **180** can comprise, for each user, one or more passwords, wherein each password is associated with a website.

In particular, for a given website, the password of the user is the password used by the user to access his account in this given website.

The user identification data **180** can also comprise one or more usernames, wherein each username is associated with a password for a given website. Indeed, a given user can have different accounts for a given website, and therefore, a different username and associated password can be stored for each account of the user for the given website.

According to some embodiments, for a given user, a plurality of different records are stored in the database (these records may be spread in the database). Each record can comprise:

- biometric data representative of biometric features of the user,
- a username,
- a password,
- data representative of a given website for which these data are relevant.

The records of a given user can be spread in the database, and their location depends on the time at which they have been created.

In some embodiments, for a given username of a user, user identification data **180** can comprise a plurality of passwords associated with a given website.

This can be due to various reasons.

In some embodiments, for a given username of a website, when a user changes his password from an old password to a new password for the given website, the old password is not deleted from the user identification data **180** but is kept, and the new password is stored in the user identification data **180** in addition to the old password. Information indicating that the new password is the “correct and updated” password can be stored in the database system **150**. For example, this information can be the fact that the new password was created in the database at a more recent time, or the fact that the new password is located in the database at a higher location, or an adapted pointer can be stored in the database, etc.

In some embodiments, when the user changes his password for a given username of a given website, a new record is added in the database, which comprises:

- biometric data representative of biometric features of the user,
- the username and associated new password for the given website,
- data representative of the given website (e.g. address, etc.).

Although the new record has been created, in some embodiments, the previous record is not deleted.

An example is shown in **Fig. 1A**, in which user 1 has changed (for his account “username 1” for “website 1”) his old password “password 1” to a new password “password 3”. Therefore, a new record **185** is created in the database, in addition to the previous record **184**.

In some embodiments, the user can have a plurality of accounts for a given website. Therefore, a plurality of passwords can be stored for this user for this given website, e.g. at least one for each account. This is shown in **Fig. 1A**, in which “user 1” has two accounts “username 1” and “username 2”, and a password for each username.

According to some embodiments, and as explained hereinafter, the password(s) stored for each user can be stored in an encrypted form.

According to some embodiments, a password stored for a user in the database and associated with a given website (for a given username), is encrypted using an encryption mechanism which allows decryption of the password only by the given website.

For example, for each user, a password associated with a given website (for a given username) is stored in an encrypted form in the database using a public key of the given website, wherein the password can be decrypted using a private key available only to the given website.

By storing data representative of the accounts of the users as explained above, this helps tracing all accounts of a given user for all websites which participate in the trusted authentication described hereinafter.

Attention is now drawn to **Fig. 2**.

When a user of a given website intends to be identified using the trusted authentication described hereinafter, he can use e.g. the user application (see **Fig. 1**) to provide, in a registration phase (operation **200**):

- biometric data (the user can use the biometric identification device **105** which senses the relevant biometric features of the user and provides the biometric data of the user to the user application, using e.g. wire/wireless communication); and
- the username and password that he uses for this given website.

In some embodiments, the user can provide further data, such as additional data relevant for this given website.

In some embodiments, the website itself comprises an interface which allows a user to register his biometric data, password and username (see reference **300** in **Fig. 3**), which will allow him later on to enter the website by providing biometric identification without providing password.

The biometric data and the password can be sent to the database system **140**, for their storage. According to some embodiments, the password is first encrypted (operation **210**) using e.g. a public key of the given website (this encryption can be performed e.g. by the user application, or by another server which stores the public key), and sent to the database system **140**. If necessary, other data stored for the user for this website can be encrypted using the public key of the website (e.g. username etc.).

The data (biometric data, encrypted password, and, if necessary, additional user data) are sent (operation **220**) to the database system **140** for their storage. As explained above, a new record is added to the database **150**.

The user can repeat these operations (**200**, **210** and **220**) for a plurality of websites (in some embodiments, the biometric data is collected once, and then the user provides a list of usernames and passwords, for each of a plurality of websites).

Attention is drawn to **Fig. 4**, which provides a method of changing a password for a given website.

Assume a user has performed the method of **Fig. 2** for a password (hereinafter old password) associated with a given website (for a given username), and he now wishes to change his old password to a new password for this given website (for this given username).

The method can comprise (operation **400**) collecting biometric data of the user, and the new password of the user (the user can enter the new password using the user application, or he can enter the new password on the website which then provides this new password e.g. to the user application to a server or processing unit).

The method can comprise (operation **410**) encrypting the new password using e.g. a public key of the given website (this is similar to operation **210**).

The method can comprise sending (operation **420**) the data to the database system **140**. The encrypted new password can be stored as a new record in the database system **140** (this new record can comprise the biometric data, the username of the user, the new password, and data indicative of the website for which these data are relevant).

As mentioned above, information indicates in the database system **140** that the new password is the latest and relevant password (e.g. a pointer indicating the date of creation of the password in the database, location of the new password relative to the old password, e.g. in a more recent block, etc.).

Attention is now drawn to **Fig. 5**.

Assume a user (who has already performed a registration procedure for a given website, such as the registration procedure described in **Fig. 2** or **Fig. 4**) intends to access the given website using e.g. his computer or cellphone.

The user needs to provide (operation **500**) biometric data. He can use the biometric identification device **105**. The biometric data is transmitted (operation **510**) from the biometric identification device **105** to the database system **140** (this transmission can be controlled e.g. by the user application and/or by the given website and/or by another server).

The method can comprise searching (operation **520**) for this biometric data in at least one database **150** of the database system **140**. The database **150** which is chosen

to perform this search can be e.g. the closest database (physical distance), or the database which is currently the less loaded, etc. This is not limitative.

This search can be performed e.g. by the user application and/or by the given website and/or by a processing unit associated with the database.

If this search reveals that biometric data stored in the database matches the biometric data of the user (according to some matching criterion, which can define the maximal difference that can be accepted between the biometric data of the user and the biometric data stored in the database), then the password associated with this given website for this user can be extracted from the database and can be sent (operation **530**) to the given website. Transmission of the database can be controlled by a processing unit associated with the database, or by the user application, or by the given website.

In some embodiments, the user provides (e.g. to the website, or using the user application) the username for which he wants to access the website. Therefore, the search can extract only the relevant password associated with the username for this website. This embodiment is illustrated in **Fig. 5**.

The given website (or another processing unit associated with the given website) can then decrypt (operation **540**) the encrypted password using its private key (which is the only key that can decrypt the password, and which is available to the given website only).

The given website now has access to the password of the user for this username, and can then authorize access (operation **550**) of the user accordingly, based on the username of the user (provided by the user) and on the unencrypted password of the user.

In other embodiments (see **Fig. 5A**), the user does not provide his username at the beginning of the identification process.

Therefore, if the search (operation **510** in **Fig. 5A**) reveals that the biometric data of the user corresponds to a plurality of usernames and passwords in the database for this website (operation **511**), then the method can comprise requesting from the user to select the relevant username for which he wants to be identified (operation **512**). Based on this input, the password associated with the selected username will be extracted and sent to the website (operation **513**). The relevant username can be also communicated to the website (e.g. from the database, or from the user application).

The method can then comprise decrypting the encrypted password (operation **515**) by the given website and allowing access to the given website by the user for this selected username (operation **516**).

If the search reveals that the biometric data of the user corresponds to a single username for this website (operation **511**), then the corresponding password, together with the single username, can be extracted and sent to the website (operations **517-518**).

The method can then comprise decrypting the encrypted password (operation **519**) by the given website and allowing access to the given website by the user for this single username (operation **521**).

In both methods of **Figs. 5** and **5A**, if a plurality of passwords is stored for this given website, for the selected username in **Fig. 5**, or for the single username in **Fig. 5A**, then the most recent password is extracted and sent to the given website.

As mentioned above, the password is generally encrypted, and therefore the encrypted password is extracted and sent to the given website.

In some embodiments, further data can be sent to the given website, such as username, personal data, etc.

The user can therefore access each website based only on biometric data, and does not need to enter a password each time for each website (although he may do so if the website keeps this option as illustrated in **Fig. 3**).

It is to be noted that the various features described in the various embodiments may be combined according to all possible technical combinations.

It is to be understood that the invention is not limited in its application to the details set forth in the description contained herein or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Hence, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting. As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for designing other structures, methods, and systems for carrying out the several purposes of the presently disclosed subject matter.

Those skilled in the art will readily appreciate that various modifications and changes can be applied to the embodiments of the invention as hereinbefore described without departing from its scope, defined in and by the appended claims.

CLAIMS

1. An identification method, comprising:
 - providing at least one decentralized ledger database storing, for each of a plurality of users, and for a set of one or more websites, user data comprising:
 - biometric data representative of biometric features of the user,
 - user identification data comprising at least one or more usernames and passwords, wherein each username and password is associated with a website of the set, wherein each password is stored in an encrypted form in the database using a public key of the website with which it is associated, wherein the password can be decrypted using a private key available only to the website with which it is associated,
 - the method comprising, by at least one processing unit:
 - obtaining biometric data representative of biometric features of a candidate user attempting to be identified by a given website of the set,
 - searching, in the database, biometric data matching the biometric data of the candidate user according to a matching criterion, and
 - sending to the given website at least a password stored for the candidate user in the database and associated with the given website, wherein the password sent to the given website is encrypted using a public key which allows decryption of the password only by the given website, based on a private key available only to the given website.
2. The identification method of claim 1, comprising sending at least a password stored for the candidate user in the database and associated with a username for which the user is attempting to be identified by the given website.
3. The identification method of claim 1, comprising:
 - based on biometric data representative of biometric features of the candidate user, searching, in the database, biometric data matching the biometric data of the candidate user according to a matching criterion,
 - determining a plurality of usernames of the candidate user for the given website,

- based on an input of the candidate user indicating a given username among said plurality of usernames, sending, to the given website, the given username and at least a password stored for the candidate user in the database and associated with the given username for the given website.
4. The method of any of claims 1 to 3, further comprising:
 - decrypting the password of the candidate user by the given website,
 - authorizing access to the given website by the candidate user based at least on a username of the user and the decrypted password.
 5. The method of any of claims 1 to 4, wherein the database stores, for at least one user, user data comprising, for a given username of the user, a plurality of passwords for a given website, wherein the method comprises:
 - sending to the given website a password which is the most recent one created in the database among the plurality of passwords stored for the candidate user in the database and associated with the given username for the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website.
 6. The identification method of any of claims 1 to 5, wherein the database is a distributed database comprising a plurality of elementary databases, wherein each of the elementary databases stores the same data, and wherein adding a new record in one of the elementary databases, propagates in all other elementary databases.
 7. The identification method of any of claims 1 to 6, wherein the database stores, for each of a plurality of users, a plurality of distinct records, each record comprising:
 - o biometric data representative of biometric features of the user, and
 - o at least one username and associated password for a website of the set.

8. The identification method of claim 7, wherein when the user changes from the password to a new password associated with the username and the given website, the method comprises creating a new record in the database comprising:
 - biometric data representative of biometric features of the user, and
 - the username and associated new password for the given website,wherein an indication that the new password has been created after the old password, is present in the database.
9. The identification method of any of claims 1 to 8, wherein the biometric data is stored using a unique mathematical representation in the database.
10. A method, comprising, by at least one processing unit:
 - obtaining biometric data representative of biometric features of a candidate user attempting to be registered in a given website,
 - obtaining a username and password provided by the candidate user for the given website,
 - encrypting the password using a public key specific to the given website,
 - storing, in at least one decentralized ledger database, user data for said candidate user, the user data comprising:
 - said biometric data,
 - said username, and
 - at least said password associated with said username for said given website,wherein the database is searchable for providing, upon request, for said username of said given website, said password in an encrypted form based on said biometric data,
wherein the password can be decrypted by a private key available only to the given website.
11. An identification method, comprising, by at least one processing unit:
 - upon attempt of a candidate user to be identified by a given website based at least on biometric data of the candidate user, obtaining a password of the

candidate user for this given website extracted from a decentralized ledger database storing, for each of a plurality of users, user data comprising:

- biometric data representative of biometric features of the user,
- user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website of a set of one or more websites, the set comprising the given website,

wherein the password is encrypted using a public key which allows decryption of the password only by the given website using a private key available only to the given website, and

- decrypting the password of the candidate user by the given website using the private key, and
- authorizing access to the given website by the candidate user based at least on the decrypted password.

12. A system configured to, by at least one processing unit:

- obtain biometric data representative of biometric features of a candidate user attempting to be identified by a given website,
- search, in at least one decentralized ledger database, biometric data matching the biometric data of the candidate user according to a matching criterion, wherein the at least one database stores, for each of a plurality of users, user data comprising:
 - biometric data representative of biometric features of the user,
 - user identification data comprising at least one or more usernames and passwords, wherein each username and password is associated with a website of a set of one or more websites, the set comprising the given website, wherein each password is stored in an encrypted form in the database using a public key of the website with which it is associated, wherein the password can be decrypted using a private key available only to the website with which it is associated,and
- send to the given website at least a password stored for the candidate user in the database and associated with the given website, wherein the password sent

to the given website is encrypted using a public key which allows decryption of the password only by the given website, based on a private key available only to the given website..

13. The system of claim 12, configured to send at least a password stored for the candidate user in the database and associated with a username for which the user is attempting to be identified by the given website.

14. The system of claim 12 or of claim 13, configured to:

- based on biometric data representative of biometric features of the candidate user, search, in the database, biometric data matching the biometric data of the candidate user according to a matching criterion,
- determine a plurality of usernames of the candidate user for the given website,
- based on an input of the candidate user indicating a given username among said plurality of usernames, send, to the given website, the given username and at least a password stored for the candidate user in the database and associated with the given username for the given website.

15. The system of any of claims 12 to 14, configured to:

- decrypt the password of the candidate user by the given website, and
- authorize access to the given website by the candidate user based at least on a username of the user and the decrypted password.

16. The system of any of claims 12 to 15, wherein the database stores, for at least one user, user data comprising, for a given username of the user, a plurality of passwords for a given website, the system being configured to:

- send to the given website a password which is the most recent one created in the database among the plurality of passwords stored for the candidate user in the database and associated with the given username for the given website, wherein the password is encrypted using an encryption mechanism which allows decryption of the password only by the given website.

17. The system of any of claims 12 to 16, wherein the database is a distributed database comprising a plurality of elementary databases, wherein each of the elementary databases stores the same data, and wherein adding a new record in one of the elementary databases propagates in all other elementary databases.
18. The system of any of claims 12 to 17, wherein, the database stores, for each of a plurality of users, a plurality of distinct records, each record comprising:
 - biometric data representative of biometric features of the user, and
 - at least one username and associated password for a website of the set.
19. The system of any of claim 18, wherein when the user changes from the password to a new password associated with the username and the given website, the system is configured to create a new record in the database comprising:
 - biometric data representative of biometric features of the user, and
 - the username and associated new password for the given website.
20. The system of any of claims 12 to 19, wherein the biometric data is stored using a unique mathematical representation in the database.
21. A system configured to, by at least one processing unit:
 - obtain biometric data representative of biometric features of a candidate user attempting to be registered in a given website,
 - obtain a username and password provided by the candidate user for the given website,
 - encrypt the password using a public key specific to the given website,
 - store, in at least one decentralized ledger database, user data for said candidate user, the user data comprising:
 - said biometric data,
 - said username, and
 - at least said password associated with said username for said given website,

wherein the database is searchable for providing, upon request, for said username of said given website, said password in an encrypted form based on said biometric data,

wherein the password can be decrypted by a private key available only to the given website.

22. A system configured to, by at least one processing unit:

- upon attempt of a candidate user to be identified by a given website based at least on biometric data of the candidate user, obtain a password of the candidate user for this given website extracted from a decentralized ledger database storing, for each of a plurality of users, user data comprising:
 - biometric data representative of biometric features of the user,
 - user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website of a set of one or more websites, the set comprising the given website,
- wherein the password is encrypted using a public key which allows decryption of the password only by the given website using a private key available only to the given website, decrypt the password of the candidate user by the given website based on the private key, and
- authorize access to the given website by the candidate user based at least on the decrypted password.

23. A non-transitory storage device readable by a processing unit, tangibly embodying a program of instructions executable by the processing unit to perform a method comprising:

- obtaining biometric data representative of biometric features of a candidate user attempting to be identified by a given website,
 - searching, in at least one decentralized ledger database, biometric data matching the biometric data of the candidate user according to a matching criterion,
- wherein the at least one database stores, for each of a plurality of users, user data comprising:

- biometric data representative of biometric features of the user,
- user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website of a set of one or more websites, the set comprising the given website, and
- sending to the given website at least a password stored for the candidate user in the database and associated with the given website, wherein the password is encrypted using a public key which allows decryption of the password only by the given website, based on a private key available only to the given website.

24. A non-transitory storage device readable by a processing unit, tangibly embodying a program of instructions executable by the processing unit to perform a method comprising:

- obtaining biometric data representative of biometric features of a candidate user attempting to be registered in a given website,
- obtaining a username and password provided by the candidate user for the given website,
- encrypting the password using a public key specific to the given website,
- storing, in at least one decentralized ledger database, user data for said candidate user, the user data comprising:
 - said biometric data,
 - said username,
 - at least said password associated with said username for said given website,

wherein the database is searchable for providing, upon request, for said username of said given website, said password in an encrypted form based on said biometric data,

wherein the password can be decrypted by a private key available only to the given website.

25. A non-transitory storage device readable by a processing unit, tangibly embodying a program of instructions executable by the processing unit to perform a method comprising:

- upon attempt of a candidate user to be identified by a given website based at least on biometric data of the candidate user, obtaining a password of the candidate user for this given website extracted from a decentralized ledger database storing, for each of a plurality of users, user data comprising:

- biometric data representative of biometric features of the user,
 - user identification data comprising at least one or more usernames and passwords, each username and password being associated with a website of a set of one or more websites, the set comprising the given website,

wherein the password is encrypted using a public key which allows decryption of the password only by the given website using a private key available only to the given website,

- decrypting the password of the candidate user by the given website using the private key, and
- authorizing access to the given website by the candidate user based at least on the decrypted password.