CLAIMS

1. Method of securing graphical data against forgery and tampering comprising the steps of:

storing in a memory of a processing unit a graphical data block (210, 310) containing a digital representation of a given finite set of graphical symbols of the graphical data;

processing with the processing unit the digital representation of graphical symbols of the stored graphical data block with an error correction code programmed in the processing unit to generate error correction data in a corresponding error correction data block (230, 330);

formatting (215, 240; 315, 340) the graphical data block and the error correction data block with the processing unit to respectively provide, in a human readable graphical data block, a human readable representation of the graphical symbols of the graphical data block and, in a machine-readable error correction data block, a machine-readable representation of the error correction data of the error correction data block separate from the human readable representation of the graphical symbols of the graphical data block, to obtain (250, 350) a corresponding verifiable graphical data block comprising said human readable graphical data block and said machine-readable error correction data block; and

(i) displaying human readable graphical symbols and corresponding machine-readable representation of error correction data of the obtained verifiable graphical data block on a support (100) being a display connected to the processing unit, or

(ii) marking (260) on a support (100) being a substrate, via a marking device connected to the processing unit and equipped with a control unit operable to control the operation of marking based on data received from the processing unit, human readable graphical symbols and corresponding machine-readable representation of error correction data of the obtained verifiable graphical data block received from the processing unit,

thereby providing on the support (100) verifiable data comprising the human readable graphical symbols and the corresponding machine-readable error correction data;

characterized in that the method comprises:

calculating with a hash function programmed on the processing unit a hash value of any portion of a data block resulting from a concatenation of the graphical data block and the error correction data block; and

storing the calculated hash value as a reference hash value in a ledger.

2. Method as claimed in claim 1, wherein the machine-readable representation of error correction data is any one of an alphanumeric representation or a barcode (130) representation.

3. Method as claimed in claim 1, wherein the graphical symbols are text (110) characters and the finite set of graphical symbols is an alphabet.

4. Method as claimed in claim 1, wherein the support (100) comprises a plurality of parts and the verifiable graphical data block is split (410) into a same plurality of verifiable graphical data sub-blocks, and the corresponding human readable graphical symbols and machine-readable representation of error correction data are accordingly spread together on corresponding parts of the support (100), by the following steps:

the graphical data block is split into a plurality of graphical data sub-blocks, and each graphical data sub-block is formatted (415) to provide a human readable representation of its graphical symbols in a corresponding human readable graphical data sub-block;

for each graphical data sub-block, the digital representation of its graphical symbols is extracted and processed (420) with the error correction code to generate (430) corresponding error correction data in an error correction data sub-block;

each error correction data sub-block is formatted to provide (440) in a corresponding machine-readable error correction data sub-block a machine-readable representation of corresponding error correction data separate from the human readable representation of graphical symbols of the corresponding human readable graphical data sub-block, to obtain (450) a corresponding verifiable graphical data sub-block comprising said human readable graphical data sub-block and said machine-readable error correction data sub-block; and

at step (i), displaying (460) human readable graphical symbols and corresponding machine-readable representation of error correction data of each obtained verifiable graphical data sub-block on the display, or

at step (ii), marking (470) on the substrate (100), via the marking device, human readable graphical symbols and corresponding machine-readable representation of error correction data of each verifiable graphical data sub-block received by the control unit from the processing unit,

thereby providing on the support (100), for each graphical data sub-block of the graphical data block, corresponding human readable graphical symbols together with corresponding machine-readable error correction data that are verifiable by a user.

5. Method as claimed in claim 4, wherein

a sub-block hash value is calculated via a hash function programmed on the processing unit for any portion of a data sub-block resulting from a concatenation of said graphical data sub-block and said error correction data sub-block;

for each sub-block hash value, a corresponding machine-readable representation of said sub-block hash value is calculated;

associated with each verifiable graphical data sub-block, the corresponding machine-readable representation of the sub-block hash value is provided on the corresponding part of the support (100);

a reference aggregated hash value of all the sub-block hash values is determined as a concatenation of all the calculated sub-block hash values; and

the reference aggregated hash value is stored in a ledger,

thereby providing on the support (100), for each graphical data sub-block of the graphical data block, corresponding human

readable graphical symbols together with corresponding machine-readable error correction data that are verifiable by a user.

6. Method as claimed in claim 4, wherein

a sub-block hash value is calculated via a hash function programmed on the processing unit for any portion of a data sub-block resulting from a concatenation of said graphical data sub-block and said error correction data sub-block;

a reference aggregated hash value of all the sub-block hash values is determined as a root node value of a tree having the calculated sub-block hash values as leaf node values, the tree comprising nodes arranged according to a given nodes ordering in the tree, said tree comprising node levels from the leaf nodes to the root node, every non-leaf node value of the tree corresponding to a hash value of a concatenation of the respective node values of its child nodes according to a tree concatenation ordering, the root node value corresponding to a hash value of a concatenation of the node values of the nodes of a penultimate nodes level in the tree according to said tree concatenation ordering;

for each sub-block hash value, an associated sub-block verification path key is determined as a series of hash values of selected non-leaf nodes of the tree necessary to retrieve the root node value from said sub-block hash value;

a machine-readable representation of each sub-block verification path key is included, associated with the respectively corresponding graphical data sub-block and error correction data sub-block, in the verifiable graphical data

sub-block, the verifiable graphical data sub-block being formatted to provide a machine-readable representation of said sub-block verification path key separate from the human readable representation of the associated graphical data sub-block and the machine-readable representation of the associated error correction data sub-block; and

(iii) the reference aggregated hash value is stored in a ledger, or

(iv) making the reference aggregated hash value available to a user,

thereby providing on the support (100), for each graphical data sub-block of the graphical data block, corresponding human readable graphical symbols together with corresponding machine-readable error correction data that are verifiable by a user.

7. Method of verifying human readable graphical symbols provided together with machine-readable representation of error correction data on a support (100), which have been generated according to the method as claimed in claim 1, comprising the steps of:

scanning (610, 710) with a scanner, equipped with an imaging unit, a scanner processing unit having a scanner memory and connected to a scanner display, human readable graphical symbols on the support (100) to obtain (620, 720), via image processing of the scanned human readable graphical symbols, a scanned graphical data block being a digital representation of said scanned human readable graphical symbols;

scanning (615, 715) with the scanner machine-readable representation of error correction data on the support (100) to obtain (625, 725), via machine-readable decoder programmed on the

scanner processing unit, corresponding scanned error correction data in a scanned error correction data block, the scanned error correction data block being a digital representation of said scanned error correction data;

correcting (630, 730) the scanned graphical data block with an error correction code programmed on the scanner processing unit using the scanned error correction data of the scanned error correction data block to obtain a corresponding corrected scanned graphical data block; and

(a) displaying (660, 760) a visual representation of the corrected scanned graphical data block as corresponding corrected human readable graphical symbols on the scanner display for the purpose of comparing the displayed visual representation of the corrected scanned graphical data block with the human readable graphical symbols provided on the support (100) to detect any alteration or fraud, or

(b) indicating (670, 770) via the scanner whether the scanned graphical data block contains an error, or

(c) storing (680, 780) scan result data specifying whether the scanned graphical data block contains an error in the scanner memory;

the method comprising the hash function being programmed on the scanner processing unit, and the scanner being connected to a scanner communication unit operable to communicate via a communication link with the ledger, characterized in that the method comprises the steps of:

calculating with the hash function programmed on the scanner processing unit a scan hash value of

any portion of a data block resulting from a concatenation of the corrected scanned graphical data block and the scanned error correction data block;

obtaining the reference hash value stored in the ledger via the scanner communication unit and the communication link, and checking whether the obtained reference hash value matches the scan hash value; and

(e) indicating a result of the checking operation, or

(f) storing a result of the checking operation in the scanner memory.

8. Method as claimed in claim 7, wherein the human readable graphical symbols and the machine-readable error correction data on the support (100) have been generated according to the method as claimed in claim 4, wherein:

the operation of scanning the human readable graphical symbols on the support (100) comprises scanning of the sub-block graphical symbols of the corresponding graphical data sub-block to obtain via image processing corresponding scanned graphical data sub-block as a digital representation of the scanned sub-block graphical symbols;

the operation of scanning the machine-readable error correction data on the support (100) comprises scanning of the error correction data of the corresponding error correction data sub-block to obtain corresponding scanned error correction data sub-block;

the operation of correcting the scanned graphical data block comprises correcting the graphical data of the scanned graphical data sub-block, using the corresponding scanned error correction

data sub-block, to obtain corresponding corrected scanned graphical data sub-block; and

the operation (a) of displaying a visual representation of the corrected scanned data block comprises displaying a visual representation of the corrected scanned graphical data sub-block;

the operation (b) of indicating whether the scanned graphical data block contains an error comprises indicating whether the scanned graphical data sub-block contains an error;

the operation (c) of storing scan result data comprises storing whether the scanned graphical data sub-block contains an error.

9. Method as claimed in claim 8, wherein the human readable graphical symbols and the machine-readable error correction data on the support (100) have been generated according to the method as claimed in claim 5, the hash function and the error correction code being programmed on the scanner processing unit, and the scanner being operable to read and decode machine-readable representation of a sub-block hash value on the support (100) via the scanner processing unit, the scanner being connected to a scanner communication unit operable to communicate via a communication link with the ledger, comprising the steps of:

calculating for each part of the support (100), with the hash function programmed on the scanner processing unit and in accordance with the operations carried out for calculating a sub-block hash value, a scan sub-block hash value of any portion of a data sub-block resulting from a concatenation of

said corrected scanned graphical data sub-block and said scanned error correction data sub-block;

in case it is not possible to calculate a scan sub-block hash value for a part of the support (100), scanning and decoding a machine-readable representation of a sub-block hash value on said part of the support (100) to obtain a corresponding decoded sub-block hash value, and using this decoded sub-block hash value as scan sub-block hash value for this part of the support (100);

calculating an aggregated scan hash value as a concatenation of all the scan sub-block hash values;

obtaining the reference aggregated hash value stored in the ledger via the scanner communication unit and the communication link, and checking whether the obtained reference aggregated hash value matches the aggregated scan hash value; and

indicating a result of the checking operation via the scanner.

10. Method as claimed in claim 8, wherein the human readable graphical symbols and the machine-readable error correction data on each part of the support (100) have been generated according to the method as claimed in claim 6, the reference aggregated hash value being stored in the ledger, the scanner being connected to a scanner communication unit operable to communicate via a communication link with the ledger, and the scanner being operable to read and decode machine-readable representation of a sub-block verification path key on a corresponding part of the support (100) and calculate an aggregated hash value from a pair of corresponding sub-block hash value and sub-block verification path key, comprising the steps of:

calculating, with the hash function programmed in the scanner processing unit and in accordance with the operations carried

out for calculating a sub-block hash value, a scan sub-block hash value of any portion of a data sub-block resulting from a concatenation of the corrected scanned graphical data sub-block and the scanned error correction data sub-block;

scanning with the scanner a machine-readable representation of a sub-block verification path key, corresponding to the selected corrected scanned graphical data sub-block, on a corresponding part of the support (100), and extracting a corresponding scanned sub-block verification path key;

calculating a scan aggregated hash value with the calculated scan sub-block hash value and the scanned sub-block verification path key;

obtaining the reference aggregated hash value stored in the ledger via the scanner communication unit and the communication link, and checking whether the obtained reference aggregated hash value matches the scan aggregated hash value; and

indicating a result of the checking operation via the scanner.

11. Method as claimed in claim 8, wherein the human readable graphical symbols and the machine-readable error correction data on the support (100) have been generated according to the method as claimed in claim 6, the reference aggregated hash value available to the user being stored in the scanner memory, and the scanner being operable to read and decode machine-readable representation of a sub-block verification path key on a corresponding part of the support (100) and calculate an aggregated hash value from a pair of corresponding sub-block hash value and

sub-block verification path key, comprising the steps of:

calculating, with the hash function programmed in the scanner processing unit and in accordance with the operations carried out for calculating a sub-block hash value, a scan sub-block hash value of any portion of a data sub-block resulting from a concatenation of the corrected scanned graphical data sub-block and the scanned error correction data sub-block;

scanning with the scanner a machine-readable representation of a sub-block verification path key, corresponding to the selected corrected scanned graphical data sub-block, on a corresponding part of the support (100), and extracting a corresponding scanned sub-block verification path key;

scanning on the support (100) a reference aggregated hash value to obtain a scanned reference aggregated hash value;

calculating an aggregated scan hash value with the calculated scan sub-block hash value and the scanned sub-block verification path key;

checking whether the reference aggregated hash value stored in the scanner memory matches the aggregated scan hash value; and

indicating a result of the checking operation via the scanner.

12. Substrate marked with verifiable data comprising human readable graphical symbols and corresponding machine-readable

error correction data according to the method as claimed in claim 1.

13. Scanner equipped with an imaging unit, a scanner processing unit, a scanner display, and a scanner communication unit operable to communicate via a communication link with a ledger, wherein the scanner processing unit is programmed to make the scanner operable to implement the steps of the method as claimed in claim 7.