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## (54) METHOD FOR CERTIFICATION OF ORGANIC PRODUCTS

(57) The present invention refers to a system which allows to verify and certify the quality of the cultivation of a product declared organic.

The system consists of a series of sensors which analyse the presence, in real time, of illegal chemical elements in the soil where the products to be declared organic are cultivated and a system of new concept hives, which exploit the work of the bees, used as carriers, to assess the surface quality of the soil near the hive.

The data collected both by the sensors placed on the soil and by the hives are sent to a blockchain platform which certifies the absolute absence of manipulation and then they populate a big data platform which, correlating the soil data and the surface data, is capable of processing an accurate analysis on the quality of the soil.

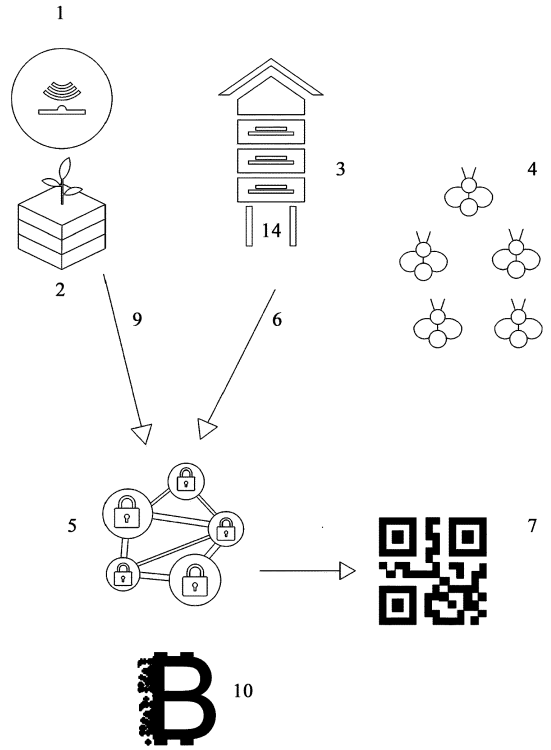


Fig. 1

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## Description

### Field of the art

**[0001]** The following invention applies to the food processing industry, in product quality certification, territorial marketing and data analytics. The proposed solution is capable of providing an organic product certification in an entirely automatic and objective manner, by collecting data that cannot be manipulated and that can autonomously and independently guarantee the organic quality thereof. The consumer and the producer have the possibility to verify all data regarding the cultivation of product subject of purchase at any time.

### State of the art

**[0002]** At the state of the art, the certification of organic products is regulated by regulation EC 834/2007, which regulates the definition of organic products and the relative process.

**[0003]** As mentioned in the regulation in article 11 "Organic farming should primarily rely on renewable resources within locally organised agricultural systems. In order to minimise the use of non-renewable resources, wastes and by-products of plant and animal origin should be recycled to return nutrients to the land.

**[0004]** And also article 12: "Organic plant production should contribute to maintaining and enhancing soil fertility as well as to preventing soil erosion. Plants should preferably be fed through the soil eco-system and not through soluble fertilisers added to the soil."

**[0005]** Supervision on whether these two articles of the regulation are complied with is currently regulated by article 27 paragraph 4 and 5 which say:

4. The due authority may:

a) confer the verification skills thereof to one other supervision authorities. The supervision authorities must offer appropriate objective and impartial assurance and have qualified personnel as well as resources required to perform their functions;
b) delegate supervision tasks to one or more supervision bodies. In such case, the member states designate the authorities in charge of certification and supervision over said bodies.

5. The competent authority may delegate tasks of control to a particular supervisory body only if they meet the conditions referred to in Article 5, paragraph 2, of regulation (EC) n° 882/2004, in particular if:

a) there is an accurate description of the tasks that the supervisory body may carry out and the conditions under which it may carry them out;
b) it is proven that the supervisory body:
i) has the experience, equipment and infrastructure required to carry out the tasks assigned thereto;
ii) has a sufficient number of suitably qualified and experienced staff;
iii) is impartial and free from any conflict of interest with regard to the execution of the tasks assigned thereto;

c) the supervisory body is accredited according to the most recent version published in the Official Journal of the European Union, series C of European Standard EN 45011 or ISO Guide 65 «General requirements relating to bodies that manage product certification systems» and is authorised by the competent authorities;
d) The supervisory body shall communicate the results of the verifications carried out by the competent authority on a regular basis and whenever the latter so requests. If the results of the verifications reveal non-compliance or raise the doubts on the same, the supervisory body shall immediately notify the competent authority;
e) there is effective coordination between the delegating competent authority and the supervisory body.

**[0006]** As observable from the articles mentioned above on the impartiality of the certifier, it is required but cannot be verified if not retrospectively and it cannot be verified with objective instruments.

**[0007]** It is interesting to mention as the known state of the art FederBIO which launched a computer project can manage the surfaces and the traceability of the productions and of transactions for organic raw materials based on a computing platform, WEB FLOW, owned by the Austrian firm Intact, already widely used in Europe, while BuiSuisse is undergoing evaluation.

**[0008]** FederBio is a federation of organizations of the entire organic and biodynamic farming production chain, having the aim of protecting and promoting the development thereof. FederBio is recognized as an institutional representative of the industry at national and regional level. It partners with IFOAM and ACCREDIA, the Italian Agency for the accreditation of certification bodies.

**[0009]** DATA BIO was created based on the collaboration between ACCREDIA and FederBio and with the aim of meeting the requirements laid down by the Technical Document RT16. It is a database owned by ACCREDIA which defines mode of operation and rules of participation for the accredited certification bodies.

**[0010]** DATABIO contains the data of the certification documents of all Italian organic operators certified by the certifying bodies accredited by ACCREDIA.

**[0011]** The database can be used by all organic operators and by consumers to verify the data relating to the certification documents of the operators.

**[0012]** In this context, it is also important to highlight a

project promoted by the Ministry of Agriculture, Food and Forestry Policies.

**[0013]** "OpenData Agricoltura" is a project promoted by the Ministry of Agriculture, Food and Forestry Policies for the view and the reuse, in an open and digital format, of a large amount of information, updated over time.

**[0014]** The "OpenData Agricoltura" project develops within a development path of the Ministry for Agricultural, Food and Forestry Policies aiming at increasing the transparency and the quality of the services to the citizen, by using of the most recent technological innovations; these objectives can also be achieved by facilitating and simplifying the disclosure of information and data offered by the Administration, through the web, to all users who may need it.

**[0015]** A series of data managed by the Ministry, classified by topic and source and freely accessible will be progressively published in this section. Furthermore, it will be available to be viewed by the citizens, used by public and private operators to conduct research or provide computer solutions or to facilitate sharing and comparing information between public national and EU agencies and institution.

**[0016]** The object of the present invention is to allow the organic certification of a product in an entirely automatic and objective manner, by collecting data that cannot be manipulated and that - in an autonomous and independent manner guarantees the organic quality thereof, thus offering the consumer and the producer the possibility of verifying all data regarding the cultivation of the product subject of purchase at any time. For the producer, the system also works pre-emptively, signalling in good time the occurrence of pollution situations which reveal abnormal values and thus allow intervening in good time.

**[0017]** A further object of the invention is to provide a system that overcomes the problem regarding the certifier impartiality which however cannot be verified unless retrospectively and it cannot be verified using objective tools.

**[0018]** Lastly, an object of the present invention is to provide a method for certification of organic products and the devices using acquisition and analysis protocols as well as search and processing the acquired data among the most common and recognised as standard in the organic certification sector, with the aim of making the implementation of the invention immediate, reliable easy to manage and maintain.

**[0019]** The aforementioned objectives are obtained through a method for the certification of organic products and a system that allows the implementation thereof, as outlined in claims 1 to 10. With the sole aim of better clarifying the invention and this without limiting the scope of protection and the sectors in which it may apply, described below are some particular embodiments, also with reference to the attached drawings.

Brief description of the drawings

**[0020]**

- Figure 1 is a schematic representation of the system for implementing the organic products certification method according to the present invention;
- Figure 2a is a representation of a possible positioning of the detection units in the area;
- Figure 2b is a representation of the positioning of the detection units on the area according to the present invention.

**[0021]** The invention subject of the present patent application consists of a system of eight elements:

i- a system of sensors 1', 1"...$1^n$ to be placed in the soil or in the vases where the product regarding which the organic certification is required is cultivated;
ii- a system of hives 3', 3"...$3^m$ with bees 4 which act as native carriers and sensors;
iii- a series of sensors 14 installed inside the hives 3', 3"...$3^m$ analysing the products of the bees therein;
iv- a data transmission system 9, 6 which collects the information originating from the sensors 14 positioned in the hives 3', 3"...$3^m$ and from those positioned in the soil 1 or in the vases, and forwards them to a dedicated blockchain 5 and to a big data system 10;
v- a blockchain infrastructure 5;
vi- a big data platform 10 with a data analytics system comprising a computer server interfaces with a data acquisition computer network;
vii- a query database for consumer use of all previously collected data;
viii-a back-office system for producer use for analysing in real time the pollution situation on the cultivated soil.

1. The system of sensors

**[0022]** The sensor 1 which is placed on the soil consists of the following components:

a- A component for analysing the chemical data of the soil. This component varies depending on the chemical data to be detected.
b- A component for geolocating the device. Through this component it is possible to identify the position of the sensor and of the soil on which the products are being cultivated.
c- A component for transmitting data. Through this component it possible to sample the results which are generated at point a) and transmit them to the cloud.
d- A supply component. Through this component it is possible to supply power to the entire system.

**[0023]** This sensorial component can also be used in stand-alone mode (without connection to the hives 3'. 3"...3$^m$) for example for analysing and drawing information regarding the quality of the soil, not only for farming, but also, in smaller scale, for cultivation in a vase (for example flowers) in a balcony or in gardens.

2. Hives

**[0024]** As mentioned previously, the analysis of the soil where the products are cultivated alone is not sufficient to guarantee that the cultivation is actually organic, in that the surrounding soils may not be cultivated according to organic processes and thus affect the quality of the products of the soil taken as reference or there can be surface pollution conditions that could not be detected by the underground sensors, such as for example the presence of smog or an incinerator not far from the cultivated soil.

**[0025]** Given that the owners of the surrounding land cannot be forced to use ground sensors 1, bees which are used as carriers for transporting the sensors to be analysed (pollen) in the smart hives 3', 3"...3$^m$ provided with sensors, are used as sensors for measuring the quality of the surrounding soil.

**[0026]** The range of action of the bees 4 is of about 6 km: a beehive monitors a circular area of about 7 sq. km (=700 ha).

**[0027]** In order to be sure to sample the entire area, monitoring stations (hives) are arranged at the vertices of triangular meshes which are spaced 2.4-2.5 km from one another.

**[0028]** A similar result would not be obtained with a square-mesh grid, because spaces without pollen collected by the bees would remain vacant.

**[0029]** A careful positioning of the hives 3', 3"...3$^m$ on the area is capable of allowing to carry out an "organic" mapping of the area, thus allowing the enhancement thereof from a territorial marketing standpoint.

**[0030]** Thus, each component of the grid consists of an equilateral triangle ABC which has on each side -AB, BC, AC- in turn the construction of a further equilateral triangle, reproducing the classic regular equilateral hexagon shape ADEFGC. This leads to the homogeneous distribution of the hives 3', 3"...3$^m$, on the area, with the aim of measuring the quality of the surrounding soil in a uniformly distributed manner, i.e. in a non-differing manner in one direction with respect to the other.

**[0031]** Figure 2b schematically shows, with the small circle, the positioning of the hive 3 on the area and, with the large circle, the zone of the area, i.e. coverage, subject of analysis in real time according to the invention.

**[0032]** The sequence of hexagons into which the entire area is divided can be assimilated to the configuration of a uniform polyhedron, i.e. a polyhedron in which all the faces are regular polygons and all vertices are "identical". But exactly what do we main by the adjective "identical"? It should be considered in the broad sense, the vertices are definitely points, and there is no doubt that all points are equal, but, besides the point, all faces reaching to that point are also taken into account in this case. Thus, scanning which is carried out by swarms of bees when they leave their beehives also occurs in an "identical" manner in that carried out in a uniform fashion.

**[0033]** Were they not identical, it cannot be argued that an objective detection system was created and thus the positioning of the hives across the area would not allow an "organic" mapping of the area in question.

3. System of sensors present in the hive

**[0034]** Using the dedicated sensors 14 positioned in the hives 3, analysing the secretions of the bees 4 allows obtaining useful information in terms of existing pollution on the surrounding soil and supplementing this information with the information produced by the underground sensors 1', 1"...1$^n$ subject of the previous point.

**[0035]** Thus, the hives 3', 3"...3$^m$ must have:

I- A system for analysing the number and the products of the bees 4.

II- A system for geolocating the hive 3 which is used along with the sensors 1'. 1"...1$^n$ placed on the ground.

III- A data transmission system 6.

IV- A system for power-supplying the devices subject of the previous points.

4. The data transmission system

**[0036]** The underground sensors and the sensors present in the hives 3', 3"...3$^m$ are interfaced in wireless mode by means of a system 6 for the secure reception and transmission of the collected data towards the blockchain platform 5 and towards the big data system 10.

5. Blockchain system

**[0037]** A blockchain 5 is basically an open and distributed ledger which can record the transactions between two parties in an efficient, verifiable and permanent manner. For this purpose, this database exploits a peer-to-peer network which is connected to a protocol for validation of new blocks.

**[0038]** Once recorded, the data in a block cannot be retroactively altered without modifying all blocks subsequent thereto, and this would require consent from the majority of the network.

**[0039]** The use of this system guarantees that all produced data cannot be altered once written in the chain. This guarantees that the consumer maximum certainty on the source, cultivation of the product about to be purchases and the producer can analyse, in real time, the quality of the products being cultivated thus intervene pre-emptively upon the occurrence of unexpected pollu-

tion situations.

**[0040]** All data produced by the ground sensors 1', 1"...$1^n$ and by the hives 3', 3"...$3^m$ is recorded on the blockchain 5.

6. Big data platform

**[0041]** All data collected by the sensors and sent by the data transmission system, is stored in the Big Data 10 thus allowing correlation and performing Data Analytics.

**[0042]** Big data analytics is the process for collecting and analysing large volumes of data to extract hidden information. Associated to sophisticated business analysis, the big data have the potential of offering businesses insights on the market conditions, customer behaviour, thus rendering decision-making more effective and quick with respect to the competitors. Various technologies and techniques for discovering hidden patterns and connection between data are available today. Their difference as compared to conventional solutions business intelligence lies in the fact that they run on big data and thus require a slower and less efficient processing.

**[0043]** Big data analytics allows predicting events. This falls within predictive analytics, given that if we have a model and we have enough historical data we can establish what will happen in the near future (a trend) with statistic bases or foundations. Bases on these predictions, one can intervene on the future by means of a prescriptive analysis, i.e. one looks for the conditions required for an event to occur. Thus, the producer pre-emptively receives information on the fact that the pollution level is moving towards out of range values before this event occurs and takes action in good time.

7. Query system for the consumer

**[0044]** The proposed system is made accessible through a website and through an app that would allow scanning QR codes fixed on the packagings of the products and automatically generated from the data stored in the reference blockchain 5. Indicated in the QR code 7 is the batch of the product which allows tracing the producer, period of cultivation, soil and thus all data collected by the sensors and present in the big data system 10 and in blockchain 5 in a secure, incontrovertible and transparent manner for the consumer.

**[0045]** In order to have information on the product, all the consumer needs to do, using the app, is focus on the QR code and scan this code to retrieve all the information regarding the product, the company, the production chain and any other information that will be useful to learn about the quality of the product about to be purchased.

8. Back office of the producer

**[0046]** Using the back-office system, the producer constantly monitors reports originating from the big data analytics system, to perform business intelligence and data mining on the collected data.

**[0047]** Further characteristics and advantages of the invention will be more apparent in light of the detailed description a preferred but non-exclusive embodiment of the system, illustrated by way of non-limiting example with reference to the attached drawings, wherein:

The sensor 1 which is planted into the soil 2 to be monitored, is designated to detect chemical elements added to alter the natural growth process of the plants. Basically, the sensor 1 acts as a small analysis laboratory.

**[0048]** The results of the analysis are sent to a blockchain 5 which certifies the data coming from the sensor in a non-alterable manner.

**[0049]** Basically, the sensors 1, 1'...$1^n$ guarantee:

i- the position of the soil, through GPS detection,
ii- the detection of a specific chemical agent,
iii- the transmission 9 of the data to a blockchain through NB-IOT.

**[0050]** As mentioned, a particular use of the present invention provides for monitoring surrounding soils using bees 4. The bees have a range of action of 6 km and always return to the same hive 3.

**[0051]** The following implementation characteristics should be observed:

- An analysis, in real time, of the data brought back by the bees 4 allows knowing the state of pollution of the surrounding soils with respect to the soil in question.
- The hives 3', 3"...$3^m$ are geo-referenced and the data is sent to the blockchain 5 where it is stored.
- The combination of the data of the ground sensors 1 and that 6 produced by the hive reveal a high level of confidence on the quality of the product that is cultivated on the soil subject of analysis.
- The QR code 7 is the means used by the end user to know the history of the product subject of purchase.

**[0052]** It should be observed that the example which strictly refers to the bee industry can also refer to other types of species of the animal kingdom. For example, extending this method to the free-range and semi-free-range ovine and bovine farming is entirely obvious and does not require particular changes to the embodiment described above. In the cases in question, it would be particularly advantageous to be able to trace the movements of the ovine or bovine animals with sensors carried by the same.

Advantages and industrial application of the invention

**[0053]** The problem relating to objectivity of producing data for certifying the organic quality of a product is radically overcome by the solution according to the present

invention. It eliminates any manipulation of the data supporting the certification. On the other hand, the consumer and the producer have the possibility to verify the quality of the cultivated products at any time by tracing the location, the soil and the data detected over time certifying the process transparently, securely, incontrovertibly and free of any kind of objection.

**[0054]** The implemented techniques guarantee that all produced data cannot be altered once written in the chain. The consumer is assured of maximum certainty on the source and on the cultivation of the product about to be purchased. On the other hand, the producer is able to analyse, in real time, the quality of the products subject of cultivation; it is crucial that the producer be capable of intervening pre-emptively upon the occurrence of unexpected pollution situations.

## Claims

1. A method for the automatic and objective organic certification of a product, based on the acquisition of data which cannot be manipulated and which can autonomously and independently guarantee the quality thereof, **characterised in that** it comprises the following operative steps:

   i- detection of data related to the soil and to the product to be monitored by means of local sensor devices (1', 1"...$1^n$), placed on the ground, underground or on the surface, regarding which the geolocation is preliminarily detected;
   ii- transmission to a platform (5) for the analysis of the detected data by means of an open and distributed ledger infrastructure of the blockchain type, acquiring the transactions in a verifiable and permanent manner by means of a peer-to-peer telecommunications network;
   iii- processing the acquired data by means of the big data platform (10) with relative big data analytics procedures, performing the analysis in the scale of large volumes of data to extract the information thereof aimed at effective and quick decision-making;
   iv- implementation of real-time query procedures on the Internet, for the consumer, by means of applications that allow to read a digital numeric code (7) inserted on the product packages and generated automatically by the data stored in the reference blockchain, indicated in such code (7) being the batch of the product, which allows to trace the producer thereof, the cultivation period, the soil and, consequently, all the data collected by the sensors (1', 1"...$1^n$) and present in the big data system (10) and in the blockchain (5) in a secure, incontrovertible and transparent manner for the consumer;
   v- implementation of back office procedures which allow the producer to constantly monitor, in real time, the reports originating from the big data analytics system (5, 10), and to perform business intelligence and data mining on the collected data.

2. A method for the automatic organic certification of a product, according to claim 1 **characterised in that** the collection of the data related to the soil and to the product to be monitored is performed by means of sensor devices (1', 1"...$1^n$) placed on the ground, regarding which the geolocation is preliminarily detected, and by means of the use of bees (4) as sensors to measure the quality of the surrounding soil, said bees being used as natural carriers for transporting the samples to be analysed inside in smart hives (3', 3"...$3^m$) provided with sensors (14), the transmission, to an analysis platform (5), of the data relating to the soil and the product, as analysed inside the hive (3), occurring by means of an open and distributed ledger infrastructure, of the blockchain type, which acquire the transactions in a verifiable and permanent manner by means of a peer-to-peer telecommunications network.

3. A method for the automatic organic certification of a product, according to claims 1 and 2, **characterised in that**, based on the processing of the acquired data, it is possible to intervene by means of a prescriptive analysis, i.e. by defining the conditions for a certain event to occur pre-emptively, by signalling in good time the occurrence of pollution situations which show values beyond the limits of normality and therefore allow to intervene in good time.

4. A method for the automatic organic certification of a product, according to the preceding claims, **characterised in that** associated with the plurality of hives (3', 3"...$3^m$) are analysis activities based on affine parametrisations regarding the positioning of the hives and the number thereof and to the products of the bees (4), with reference to the geolocation of the hives (3', 3"...$3^m$) used along with the sensors (1', 1"...$1^n$) placed on the ground, for the subsequent transmission of data to the analysis platform (5).

5. A method for the automatic organic certification of a product, according to the preceding claims, **characterised in that** the monitoring stations, comprised in the hives (3', 3"...$3^m$), are arranged at the vertices of triangular meshes, each single component of the map consisting of an equilateral triangle (ABC), reproducing the configuration of the regular equilateral hexagon (ADEFGC), thus obtaining a homogeneous distribution of the hives (3', 3"...$3^m$) on the area, so as to perform the measurements of the quality of the surrounding soil in a uniformly distributed manner.

**6.** A method for the automatic organic certification of a product, according to claim 4, **characterised in that** the monitoring stations, comprised in the hives (3', 3"...$3^m$), are arranged at the vertices of a triangular mesh, which are spaced 2.4 - 2.5 Km from one another, so that the range of action of the bees is of about 6 km, a hive controlling a circular area of about 7 sq. km.

**7.** A system for the automatic and objective organic certification of a product, based on the acquisition of data which may cannot be manipulated and which can autonomously and independently guarantee the quality thereof, according to the method of the preceding claims **characterised in that** it comprises:

i- a series of sensor devices (1', 1"...$1^n$) to be placed in the soil or in the vases where the product regarding which the organic certification is required is cultivated;
ii- a plurality of hives (3', 3"...$3^m$) with bees which act as native carriers and sensors;
iii- a series of sensors (14) installed inside the hives (3) analysing the products of the bees (4) therein;
iv- a data transmission apparatus (6, 9) which collects the information originating from the sensors positioned in the hives (3', 3"...$3^m$) and from those positioned in the soil or in the vases, and forwarding them to a dedicated blockchain (5) and to a big data system (10);
v- a dedicated blockchain infrastructure (5);
vi- a big data platform (10) with a data analytics system;
vii- a query database for consumer use of all previously collected data;
viii- a back-office database for producer use for analysing in real time the pollution situation on the cultivated soil.

**8.** A system for the automatic and objective organic certification of a product, according to the preceding claims **characterised in that** each sensor device (1) placed on the ground comprises the following constituent components:

a-a component for the analysis of the chemical data of the soil, this component varying according to which chemical element is to be detected,
b- a component for the geolocation of the device, by means of which it is possible to identify the position of the sensor and of the soil on which the products are being cultivated,
c-a component for the transmission of data, by means of such component being it possible to sample the results which are generated at point a) and transmit them to the cloud,
d- a component for the power supply, by means of which it is possible to supply power to the whole system.

**9.** A system for the automatic and objective organic certification of a product according to the preceding claims **characterised in that** the sensor device (1) is also used in stand-alone mode for the analysis and the acquisition of information relating to the quality of the soil for cultivation, on a small scale, such as flowers in vases.

**10.** A system for the automatic and objective organic certification of a product, according to the method of the preceding claims **characterised in that** it is used, also with other animal species, such as in the field of sheep and cattle grazing freely and/or semi-freely, detecting the movements thereof with sensors supported by them.

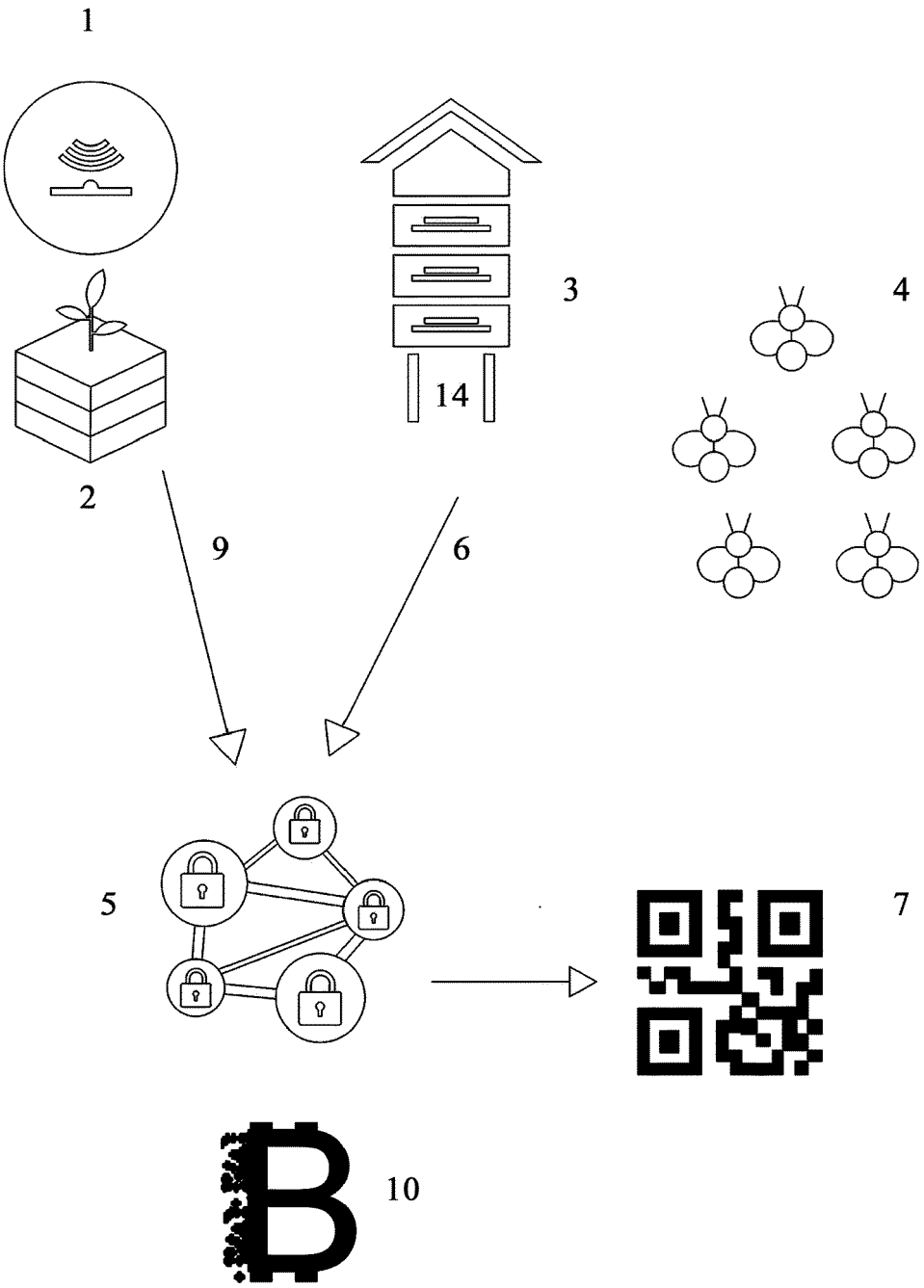


Fig. 1

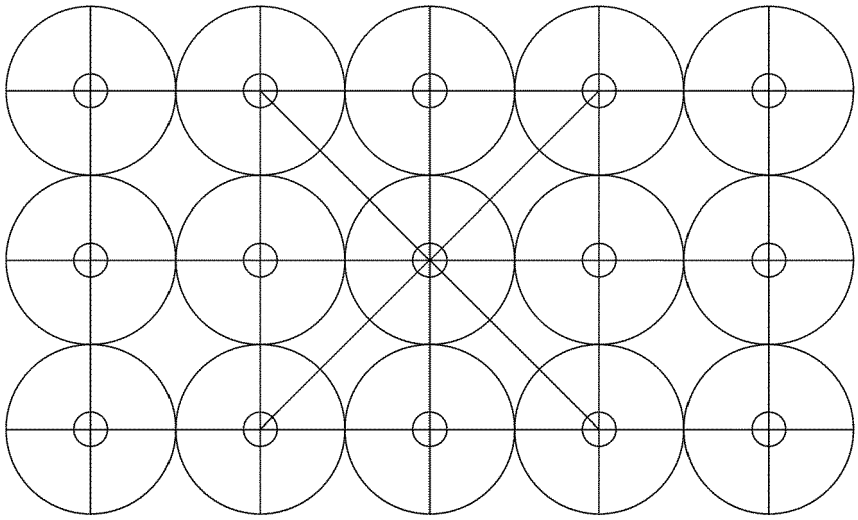

Fig. 2A

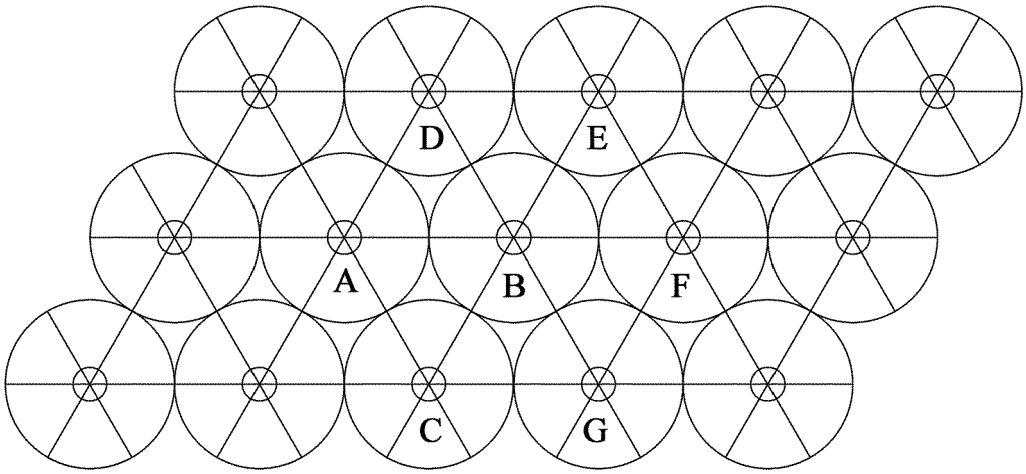


Fig. 2B

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# EUROPEAN SEARCH REPORT

Application Number
EP 19 16 9477

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X | BENDRE M R ET AL: "Big data in precision agriculture: Weather forecasting for future farming", 2015 1ST INTERNATIONAL CONFERENCE ON NEXT GENERATION COMPUTING TECHNOLOGIES (NGCT), IEEE, 4 September 2015 (2015-09-04), pages 744-750, XP032842947, DOI: 10.1109/NGCT.2015.7375220 [retrieved on 2016-01-07] * the whole document * | 1-10 | INV. G06Q50/02 |
| X | LUIS RUIZ-GARCIA ET AL: "A Review of Wireless Sensor Technologies and Applications in Agriculture and Food Industry: State of the Art and Current Trends", SENSORS, vol. 9, no. 6, 16 June 2009 (2009-06-16), pages 4728-4750, XP055070448, DOI: 10.3390/s90604728 * page 4729, line 9 - line 10 * * page 4735, paragraph 5.2 - page 4740, paragraph 5.5 * | 1-10 | TECHNICAL FIELDS SEARCHED (IPC) G06Q |
| A | Anonymous: "Blockchain - Wikipedia", , 13 June 2017 (2017-06-13), XP055408908, Retrieved from the Internet: URL:https://en.wikipedia.org/w/index.php?title=Blockchain&oldid=785374674 [retrieved on 2017-09-21] * page 1, line 1 - line 13 * | 1-10 | |

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 31 July 2019 | Arbutina, Ljiljana |

CATEGORY OF CITED DOCUMENTS

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
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