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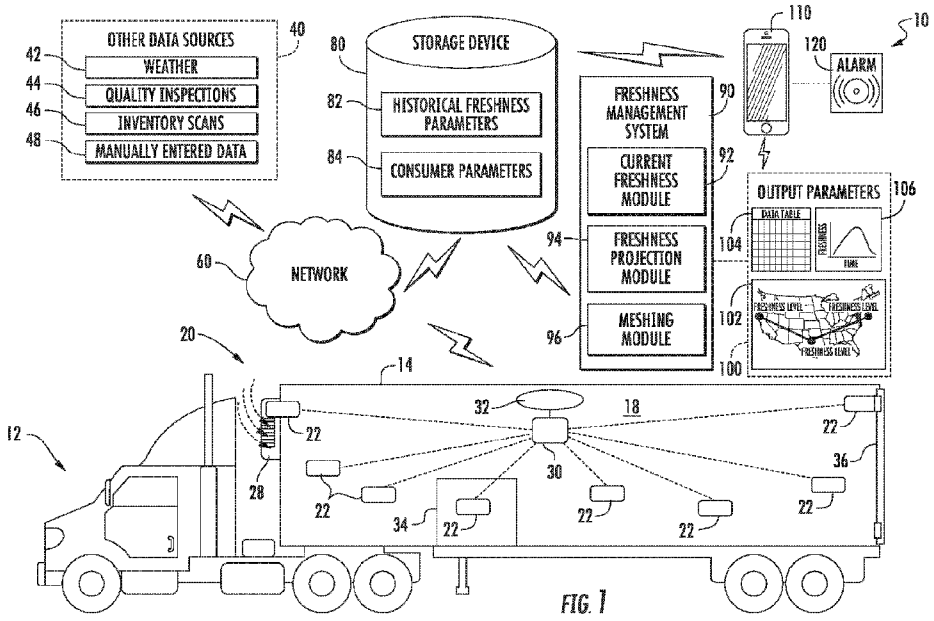

(57) Abstract: A system for monitoring the freshness of perishable goods including: a storage device (80) to store consumer parameters (84) and historical freshness parameters (82) associated with the perishable goods; a freshness management system (90) coupled to the storage device. The freshness management system including: a current freshness module (92) to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters; a freshness projection module (94) to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and a meshing module (96) to determine output parameters (100) in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

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TRACKING AND SUGGESTING COLD CHAIN MANAGER

BACKGROUND OF THE DISCLOSURE

[0001] The embodiments disclosed herein generally relate to cold chain distribution systems, and more specifically to an apparatus and a method for monitoring freshness of perishable goods.

[0002] Typically, cold chain distribution systems are used to transport and distribute perishable goods and environmentally sensitive goods (herein referred to as perishable goods) that may be susceptible to temperature, humidity, and other environmental factors. Perishable goods may include but are not limited to fruits, vegetables, grains, beans, nuts, eggs, dairy, seed, flowers, meat, poultry, fish, ice, and pharmaceuticals. Advantageously, cold chain distribution systems allow perishable goods to be effectively transported and distributed without damage or other undesirable effects.

[0003] Refrigerated trucks and trailers are commonly used to transport perishable goods in a cold chain distribution system. A transport refrigeration system is mounted to the truck or to the trailer in operative association with a cargo space defined within the truck or trailer for maintaining a controlled temperature environment within the cargo space.

[0004] Conventionally, transport refrigeration systems used in connection with refrigerated trucks and refrigerated trailers include a transport refrigeration unit having a refrigerant compressor, a condenser with one or more associated condenser fans, an expansion device, and an evaporator with one or more associated evaporator fans, which are connected via appropriate refrigerant lines in a closed refrigerant flow circuit. Air or an air/ gas mixture is drawn from the interior volume of the cargo space by means of the evaporator fan(s) associated with the evaporator, passed through the airside of the evaporator in heat exchange relationship with refrigerant whereby the refrigerant absorbs heat from the air, thereby cooling the air. The cooled air is then supplied back to the cargo space.

[0005] Consumers are becoming increasingly concerned with the origin of the perishable goods they are purchasing, as well as freshness level. It is often difficult to predict the freshness of perishable goods as the perishable goods may change hands several times along the route. Thus, making it difficult for consumers to gage freshness at the time of purchase. Improved systems, particularly improved tracking and freshness prediction systems would provide benefits to the industry.

BRIEF DESCRIPTION OF THE DISCLOSURE

[0006] According to one embodiment, a system for monitoring the freshness of perishable goods is provided. The system including: a storage device to store consumer parameters and historical freshness parameters associated with the perishable goods; a freshness management system coupled to the storage device. The freshness management system including: a current freshness module to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters; a freshness projection module to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and a meshing module to determine output parameters in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

[0007] In addition to one or more of the features described above, or as an alternative, further embodiments of the system may include a user device configured to transmit the consumer parameters to the storage device and receive output parameters from the freshness management system.

[0008] In addition to one or more of the features described above, or as an alternative, further embodiments of the system may include that the user device transmits the consumer parameters through at least one of passive transmission, active transmission, and automatic transmission.

[0009] In addition to one or more of the features described above, or as an alternative, further embodiments of the system may include that the output parameters are configured as at least one of a map displaying time-based locations of the perishable goods along with the output parameters at the time-based locations, a data table of output parameters, and a freshness versus time graph.

[0010] In addition to one or more of the features described above, or as an alternative, further embodiments of the system may include a user device activates an alarm when the perishable goods reach a selected freshness level.

[0011] In addition to one or more of the features described above, or as an alternative, further embodiments of the system may include at least one sensor configured to monitor the historical freshness parameters of the perishable goods and transmit the historical freshness parameters to the storage device.

[0012] In addition to one or more of the features described above, or as an alternative, further embodiments of the system may include that the output parameters include alternative

perishable goods when the perishable good does not satisfy consumer freshness ripeness requirements.

[0013] According to another embodiment, a method of monitoring the freshness of perishable goods is provided. The method including: storing, using a storage device, consumer parameters and historical freshness parameters associated with the perishable goods; analyzing, using a freshness management system, the historical freshness parameters and the consumer parameters. The freshness management system coupled to the storage device. The freshness management system including: a current freshness module to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters; a freshness projection module to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and a meshing module to determine output parameters in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

[0014] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include transmitting, using a user device, consumer parameters to the storage device.

[0015] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include receiving, using a user device, output parameters from the freshness management system.

[0016] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include that the user device transmits the consumer parameters through at least one of passive transmission, active transmission, and automatic transmission.

[0017] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include that the output parameters are configured as at least one of a map displaying time-based locations of the perishable goods along with the output parameters at the time-based locations, a data table of output parameters, and a freshness versus time graph.

[0018] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include activating, using a user device, an alarm when the perishable goods reach a selected freshness level.

[0019] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include: monitoring, using at least one sensor, the

historical freshness parameters of the perishable goods; and transmitting the historical freshness parameters to the storage device.

[0020] In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include that the output parameters include alternative perishable goods when the perishable good does not satisfy consumer freshness ripeness requirements.

[0021] According to another embodiment, a computer program product tangibly embodied on a computer readable medium is provided. The computer program product including instructions that, when executed by a processor, cause the processor to perform operations. The operations including: storing, using a storage device, consumer parameters and historical freshness parameters associated with the perishable goods; and analyzing, using a freshness management system, the historical freshness parameters and the consumer parameters. The freshness management system coupled to the storage device. The freshness management system including: a current freshness module to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters; a freshness projection module to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and a meshing module to determine output parameters in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

[0022] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the operations further include transmitting, using a user device, consumer parameters to the storage device.

[0023] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the operations further include receiving, using a user device, output parameters from the freshness management system.

[0024] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the user device transmits the consumer parameters through at least one of passive transmission, active transmission, and automatic transmission.

[0025] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the output parameters are configured as at least one of a map displaying time-based locations of the perishable goods

along with the output parameters at the time-based locations, a data table of output parameters, and a freshness versus time graph.

[0026] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the operations further include activating, using a user device, an alarm when the perishable goods reach a selected freshness level.

[0027] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the operations further include: monitoring, using at least one sensor, the historical freshness parameters of the perishable goods; and transmitting the historical freshness parameters to the storage device.

[0028] In addition to one or more of the features described above, or as an alternative, further embodiments of the computer program may include that the output parameters include alternative perishable goods when the perishable good does not satisfy consumer freshness ripeness requirements.

[0029] Technical effects of embodiments of the present disclosure include tracking various freshness parameters of perishable goods and using the freshness parameters to predict a freshness level of the perishable goods.

[0030] The foregoing features and elements may be combined in various combinations without exclusivity, unless expressly indicated otherwise. These features and elements as well as the operation thereof will become more apparent in light of the following description and the accompanying drawings. It should be understood, however, that the following description and drawings are intended to be illustrative and explanatory in nature and non-limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The subject matter which is regarded as the disclosure is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features and advantages of the disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0032] FIG. 1 illustrates a schematic view of a system for monitoring freshness of perishable goods, according to an embodiment of the present disclosure;

[0033] FIG. 2 illustrates a schematic view a cold chain distribution system that may incorporate embodiments of the present disclosure; and

[0034] FIG. 3 is a flow diagram illustrating a method of monitoring freshness of perishable goods, according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0035] Referring now to the drawings, FIG. 1 illustrates a schematic view of a system 10 for monitoring freshness of perishable goods, according to an embodiment of the present disclosure. FIG. 2 illustrates a schematic view a cold chain distribution system 200 that may incorporate embodiments of the present disclosure. Typically, transport refrigeration systems 20 are used to transport and distribute perishable goods and environmentally sensitive goods (herein referred to as perishable goods 34). In the illustrated embodiment, a transport refrigeration system 20 includes an environmentally controlled container 14, a transport refrigeration unit 28 and perishable goods 34. The container 14 may be pulled by a tractor 12. It is understood that embodiments described herein may be applied to shipping containers that are shipped by rail, sea, or any other suitable container, without use of a tractor 12. The container 14 may define an interior compartment 18.

[0036] In the illustrated embodiment, the transport refrigeration unit 28 is associated with a container 14 to provide desired environmental parameters, such as, for example temperature, pressure, humidity, carbon dioxide, ethylene, ozone, light exposure, vibration exposure, and other conditions to the interior compartment 18. In further embodiments, the transport refrigeration unit 28 is a refrigeration system capable of providing a desired temperature and humidity range. The perishable goods 34 may include but are not limited to fruits, vegetables, grains, beans, nuts, eggs, dairy, seed, flowers, meat, poultry, fish, ice, blood, pharmaceuticals, or any other suitable cargo requiring cold chain transport.

[0037] In the illustrated embodiment, the transport refrigeration system 20 includes sensors 22. The sensors 22 may be utilized to monitor historical freshness parameters 82 of the perishable goods 34. The historical freshness parameters 82 monitored by the sensors 22 may include but are not limited to temperature, pressure, humidity, carbon dioxide, ethylene, ozone, light exposure, vibrations, and other conditions in the interior compartment 18. Accordingly, suitable sensors 22 are utilized to monitor the desired historical freshness parameters 82. Advantageously, sensors 22 may be selected for certain applications depending on the type of perishable goods 34 to be monitored and the corresponding environmental sensitivities. In an embodiment, temperatures are monitored. As seen in FIG. 1, the sensors 22 may be placed directly on the perishable goods 34.

[0038] The sensors 22 may be placed in a variety of locations including but not limited to on the transport refrigeration unit 28, on a door 36 of the container 14 and throughout the interior compartment 18. The sensors 22 may be placed directly within the transport refrigeration unit 28 to monitor the performance of the transport refrigeration unit 28. As seen,

the sensors 22 may also be placed on the door 36 of the container 14 to monitor the position of the door 36. Whether the door 36 is open or closed affects both the temperature of the container 14 and the perishable goods 34. For instance, in hot weather, an open door 36 will allow cooled air to escape from the container 14, causing the temperature of the interior compartment 18 to rise, thus affecting the temperature of the perishable goods 34. Additionally, a global positioning system (GPS) location may also be detected by the sensors 22. The GPS location may help in providing time-based location information for the perishable goods 34 that will help in tracking the travel route and other historical freshness parameters 82 along that route. For instance, the GPS location may also help in providing information from other data sources 40 regarding weather 42 experienced by the container 14 along the travel route. The local weather 42 affects the temperature of the container 14 and thus may affect the temperature of the perishable goods 34.

[0039] As illustrated in FIG. 1, the transport refrigeration system 20 may further include, a controller 30 configured to log a plurality of readings from the sensors 22, known as the historical freshness parameters 82, at a selected sampling rate. The controller 30 may be enclosed within the transport refrigeration unit 28 or separate from the transport refrigeration unit 28 as illustrated. The historical freshness parameters 82 may further be augmented with time, location stamps or other relevant information. The controller 30 may also include a processor (not shown) and an associated memory (not shown). The processor may be but is not limited to a single-processor or multi-processor system of any of a wide array of possible architectures, including field programmable gate array (FPGA), central processing unit (CPU), application specific integrated circuits (ASIC), digital signal processor (DSP) or graphics processing unit (GPU) hardware arranged homogenously or heterogeneously. The memory may be but is not limited to a random access memory (RAM), read only memory (ROM), or other electronic, optical, magnetic or any other computer readable medium.

[0040] In an illustrated embodiment, the transport refrigeration system 20 may include a communication module 32 in operative communication with the controller 30 and in wireless operative communication with a network 60. The communication module 32 is configured to transmit the historical freshness parameters 82 to the network 60 via wireless communication. The wireless communication may be, but is not limited to, radio, microwave, cellular, satellite, or another wireless communication method. The network 60 may be but is not limited to satellite networks, cellular networks, cloud computing network, wide area network, or another type of wireless network. The communication module 32 may include a short range interface,

wherein the short range interface includes at least one of: a wired interface, an optical interface, and a short range wireless interface.

[0041] Historical freshness parameters 82 may also be provided by other data sources 40, as illustrated in FIG.1. These other data sources 40 may be collected at any point throughout the cold chain distribution system 200, which as illustrated in FIG. 2 may include harvest 204, packing 206, storage prior to transport 208, transport to distribution center 210, distribution center 212, transport to display 214, storage prior to display 216, display 218 and consumer 220. These stages are provided for illustrative purposes and a distribution chain may include fewer stages or additional stages, such as, for example a cleaning stage, a processing stage, and additional transportation stages. The other data sources 40 may include, but are not limited to, weather 42, quality inspections 44, inventory scans 46, and manually entered data 48. The weather 42, as discussed above, has an effect on the operation of the transport refrigeration unit 28 by influencing the temperature of the container 14 during transport (e.g., 210 and 214) but the weather 42 also has other influences on the transport refrigeration unit 28. For instance, the weather 42 prior to and at harvest 204 may have an impact on the quality of the perishable goods 34, which may affect freshness. Moreover, quality inspections 44, similar to the weather 42, may reveal data of the perishable goods 34 that affects freshness. For instance, a particular batch of strawberries may have been subjected to rainfall prior to or at harvest 204, making them prone to spoilage. Quality inspections 44 may be done by a machine or a human being. Quality inspections 44 performed by a machine may be accomplished using a variety of techniques including but not limited to optical, odor, soundwave, infrared, or physical probe.

[0042] Further, inventory scans 46 may also reveal historical freshness parameters 82 about the perishable goods 34 and may help in tracking the perishable goods 34. For instance, the inventory scan 46 may reveal the time, day, truck the perishable goods arrived on, which may help identify the farm if previously unknown. While the system 10 includes sensors 22 to aid in automation, often times the need for manual data entry is unavoidable. The manually entered data 48 may be input via a variety of devices including but not limited to a cellular phone, tablet, laptop, smartwatch, a desktop computer or any other similar data input device known to one of skill in the art.

[0043] Historical freshness parameters 82 collected throughout each stage of the cold chain distribution system 200 may include environment conditions experienced by the perishable goods 34 such as, for example, temperature, pressure, humidity, carbon dioxide, ethylene, ozone, vibrations, light exposure, weather, time and location. For instance,

strawberries may have experienced an excessive shock or were kept at 34°F during transport. Historical freshness parameters 82 may further include attributes of the perishable goods 34 such as, for example, temperature, weight, size, sugar content, maturity, grade, ripeness, labeling, and packaging. For instance, strawberries may be packaged in 1 pound clamshells, be a certain weight or grade, be organic, and have certain packaging or labels on the clamshells. Historical freshness parameters 82 may also include information regarding the operation of the environmental control unit 28, as discussed above. The historical freshness parameters 82 may further be augmented with time, location stamps or other relevant information.

[0044] In the illustrated embodiment, the system 10 further includes a storage device 80 to store the historical freshness parameters 82 associated with the perishable goods 34 of a distribution chain. At least one of the historical freshness parameters 82 may be received from a transport refrigeration system. The storage device 80 is connected to the communication module 32 through the network 60. As shown, the storage device 80 also stores consumer parameters 84. The storage device 80 may be but is not limited to a random access memory (RAM), read only memory (ROM), or other electronic, optical, magnetic or any other computer readable medium.

[0045] In the illustrated embodiment, the system 10 further includes a freshness management system 90. The freshness management system 90 is connected to the communication module 32 through the network 60. The freshness management system 90 is also coupled to the storage device 80. As shown, the freshness management system 90 includes a current freshness module 92, a freshness projection module 94, and a meshing module 96. The freshness management system 90 may also include a processor (not shown) and an associated memory (not shown). The associated memory may be the storage device 80. The processor may be but is not limited to a single-processor or multi-processor system of any of a wide array of possible architectures, including field programmable gate array (FPGA), central processing unit (CPU), application specific integrated circuits (ASIC), digital signal processor (DSP) or graphics processing unit (GPU) hardware arranged homogenously or heterogeneously. The memory may be but is not limited to a random access memory (RAM), read only memory (ROM), or other electronic, optical, magnetic or any other computer readable medium. The current freshness module 92, the freshness projection module 94, and the meshing module 96 may be implemented in software as applications executed by the processor of freshness management system 90.

[0046] The current freshness module 92 determines current freshness parameters of the perishable goods 34 in response to the historical freshness parameters 82. The freshness

projection module 94 determines predicted freshness parameters of the perishable goods 34 in response to historical freshness parameters 82 and consumer parameters 84. Consumer parameters 84 may include information regarding: the geolocation of the consumer at the time of purchasing the perishable goods 34, the time when the perishable goods 34 were purchased, the type of perishable goods 34 (ex: bananas), the brand of perishable goods 34, how the perishable goods 34 will be stored, and when the perishable goods 34 will be consumed. Some of the consumer parameters 84 may be collected passively (i.e. passive transmission) by the user device 110 such as, for example, tracking the time and location of the consumer at the time the perishable goods 34 were purchased. Conversely, some consumer parameters 84 may have to be actively entered (i.e. active transmission) into a user device 110 such as, for example how the perishable goods 34 will be stored and when the perishable goods 34 will be consumed. Further some consumer parameters may be collected automatically (i.e. automatic transmission) when the consumer scans an ID tag of the perishable goods 34 with their user device 110, such as, for example the type of perishable goods 34 and the brand of perishable goods 34. The ID tag may be a Universal Product Code (UPC) bar code, Quick Response (QR) code, or another identification methodology known to one of skill in the art.

[0047] The freshness projection module 94 determines predicted freshness parameters of the perishable goods 34 in response to the historical freshness parameters 82 and the consumer parameters 84. The meshing module 96 determines output parameters 100 in response to at least one of the historical freshness parameters 82, the consumer parameters 84, the current freshness parameters, and the predicted freshness parameters. In an embodiment, the output parameters 100 may include the freshness of the perishable goods 34 at a particular time and location.

[0048] The output parameters 100 may be accessible via the user device 110 and/or sent directly to the user device 110. The user device 110 may be a device such as, for example, a cellular phone, tablet, laptop, smartwatch, desktop computer or any similar device. The output parameters 100 may be configured as at least one of a map 102 displaying time-based locations of the perishable goods 34 along with the output parameters 100 at the time-based locations, a data table 104 of output parameters 100, a freshness versus time graph 106, a text write-up (not shown), or any other method of displaying output parameters known to one of skill in the art. The granularity of the output parameters 100 may be adjusted depending on whom is accessing the output parameters 100 via the user device 110. For instance, employees of a cold chain distribution company may have access to more output parameters 100 at a higher granularity than the consumer. The consumer may be able to enter in some information

into their user device 110 or scan the ID tag of the perishable good 34 and immediately have access to output parameters 100 that detail the entire journey of the perishable good 34 from harvest 204 to consumer 220 and freshness along the journey. For instance, the consumer may be able to see the route the perishable goods 34 had taken from farm-to-fork and the freshness of the perishable goods 34 throughout that route. In the event that a particular perishable good might not satisfy consumer freshness requirements, the freshness management system 90 may be able to suggest an alternative perishable good through the user device 110 that might satisfy consumer freshness ripeness requirements. For instance, if one brand of tomatoes might not be ripe enough for a consumer to cook tonight, the freshness management system 90 may suggest another brand of tomatoes that might be ripe to cook tonight or even another ingredient to replace tomatoes in the consumer's recipe. Further, the freshness management system 90 may be able to send a reminder through the user device 110 via an alarm 120 indicating that the perishable good is now at a selected freshness level. For instance, a consumer may have bought tomatoes several days ago and the freshness management system 90 will use the user device 110 to send an alert 120 to the consumer that the tomatoes are now ripe and ready to be cooked.

[0049] Referring now also to FIG. 3, which shows a flow diagram illustrating a method 300 of monitoring freshness of perishable goods 34, according to an embodiment of the present disclosure. At block 304, the storage device 80 stores consumer parameters 84 and historical freshness parameters 82 associated with the perishable goods 34. At block 306, the freshness management system 90 analyzes the historical freshness parameters 82 and the consumer parameters 84. The freshness management system 90 is coupled to the storage device 80. As described above, the freshness management system 90 includes: the current freshness module 92 to determine a current freshness parameter of the perishable goods 34 in response to the historical freshness parameters 82; the freshness projection module 94 to determine predicted freshness parameters of the perishable goods 34 in response to the historical freshness parameters 82 and the consumer parameters 84; and the meshing module 96 to determine output parameters 100 in response to at least one of the historical freshness parameters 82, the consumer parameters 84, the current freshness parameters, and the predicted freshness parameters.

[0050] At block 308, the user device 110 may transmit consumer parameters 84 to the storage device 80. At block 310, the user device 110 may receive output parameters 100 from the freshness management system 90. The method 300 may also include that the user device 110 activates an alarm 120 when the perishable goods 34 reach a selected freshness level.

Further, the method 300 may include using at least one sensor 22 to monitor the historical freshness parameters 82 of the perishable goods 34. Additionally, the method 300 may include transmitting the historical freshness parameters 82 to the storage device 80.

[0051] While the above description has described the flow process of FIG. 3 in a particular order, it should be appreciated that unless otherwise specifically required in the attached claims that the ordering of the steps may be varied.

[0052] While the disclosure has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the disclosure is not limited to such disclosed embodiments. Rather, the disclosure can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the scope of the disclosure. Additionally, while various embodiments of the disclosure have been described, it is to be understood that aspects of the disclosure may include only some of the described embodiments. Accordingly, the disclosure is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

CLAIMS:

What is claimed is:

1. A system for monitoring the freshness of perishable goods, the system comprising:

a storage device to store consumer parameters and historical freshness parameters associated with the perishable goods;

a freshness management system coupled to the storage device, the freshness management system including:

a current freshness module to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters;

a freshness projection module to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and

a meshing module to determine output parameters in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

2. The system of claim 1, further comprising:

a user device configured to transmit the consumer parameters to the storage device and receive output parameters from the freshness management system.

3. The system of claim 2, wherein:

the user device transmits the consumer parameters through at least one of passive transmission, active transmission, and automatic transmission.

4. The system of claim 1, wherein:

the output parameters are configured as at least one of a map displaying time-based locations of the perishable goods along with the output parameters at the time-based locations, a data table of output parameters, and a freshness versus time graph.

5. The system of claim 1, further comprising:

a user device activates an alarm when the perishable goods reach a selected freshness level.

6. The system of claim 1, further comprising:

at least one sensor configured to monitor the historical freshness parameters of the perishable goods and transmit the historical freshness parameters to the storage device.

7. The system of claim 1, wherein:

the output parameters include alternative perishable goods when the perishable good does not satisfy consumer freshness ripeness requirements.

8. A method of monitoring the freshness of perishable goods, the method comprising:

storing, using a storage device, consumer parameters and historical freshness parameters associated with the perishable goods;

analyzing, using a freshness management system, the historical freshness parameters and the consumer parameters, the freshness management system coupled to the storage device, the freshness management system including:

a current freshness module to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters;

a freshness projection module to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and

a meshing module to determine output parameters in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

9. The method of claim 8, further comprising:

transmitting, using a user device, consumer parameters to the storage device.

10. The method of claim 8, further comprising:

receiving, using a user device, output parameters from the freshness management system.

11. The method of claim 9, wherein:

the user device transmits the consumer parameters through at least one of passive transmission, active transmission, and automatic transmission.

12. The method of claim 8, wherein:

the output parameters are configured as at least one of a map displaying time-based locations of the perishable goods along with the output parameters at the time-based locations, a data table of output parameters, and a freshness versus time graph.

13. The method of claim 8, further comprising:

activating, using a user device, an alarm when the perishable goods reach a selected freshness level.

14. The method of claim 8, further comprising:

monitoring, using at least one sensor, the historical freshness parameters of the perishable goods; and

transmitting the historical freshness parameters to the storage device.

15. The method claim 8, wherein:

the output parameters include alternative perishable goods when the perishable good does not satisfy consumer freshness ripeness requirements.

16. A computer program product tangibly embodied on a computer readable medium, the computer program product including instructions that, when executed by a processor, cause the processor to perform operations comprising:

storing, using a storage device, consumer parameters and historical freshness parameters associated with the perishable goods;

analyzing, using a freshness management system, the historical freshness parameters and the consumer parameters, the freshness management system coupled to the storage device, the freshness management system including:

a current freshness module to determine a current freshness parameter of the perishable goods in response to the historical freshness parameters;

a freshness projection module to determine predicted freshness parameters of the perishable goods in response to the historical freshness parameters and the consumer parameters; and

a meshing module to determine output parameters in response to at least one of the historical freshness parameters, the consumer parameters, the current freshness parameters, and the predicted freshness parameters.

17. The computer program of claim 16, wherein the operations further comprise:

transmitting, using a user device, consumer parameters to the storage device.

18. The computer program of claim 16, wherein the operations further comprise:

receiving, using a user device, output parameters from the freshness management system.

19. The computer program of claim 17, wherein:

the user device transmits the consumer parameters through at least one of passive transmission, active transmission, and automatic transmission.

20. The computer program of claim 16, wherein:

the output parameters are configured as at least one of a map displaying time-based locations of the perishable goods along with the output parameters at the time-based locations, a data table of output parameters, and a freshness versus time graph.

21. The computer program of claim 16, wherein the operations further comprise:

activating, using a user device, an alarm when the perishable goods reach a selected freshness level.

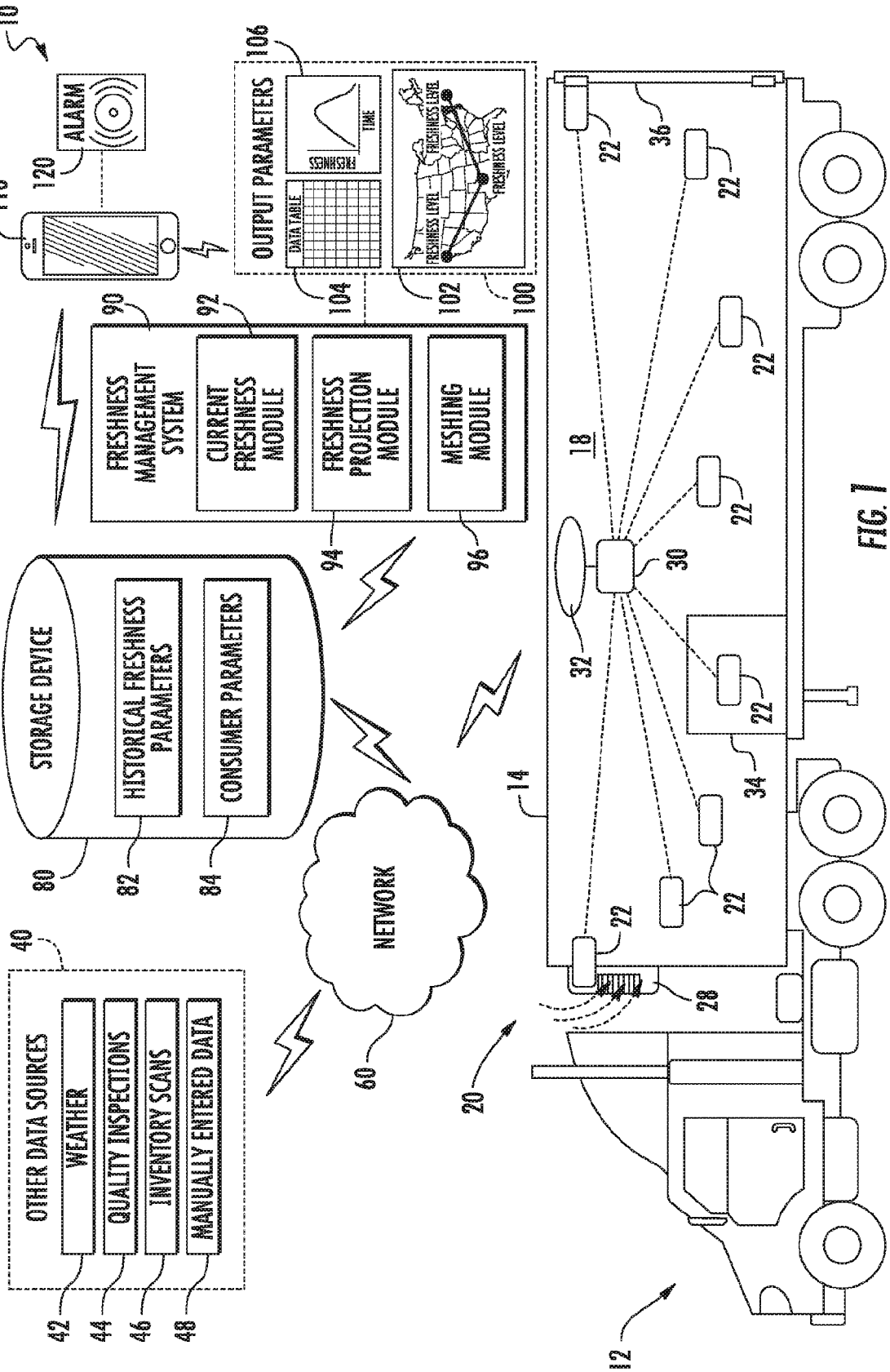
22. The computer program of claim 16, wherein the operations further comprise:

monitoring, using at least one sensor, the historical freshness parameters of the perishable goods; and

transmitting the historical freshness parameters to the storage device.

23. The computer program of claim 16, wherein:

the output parameters include alternative perishable goods when the perishable good does not satisfy consumer freshness ripeness requirements.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ALARM
120
110
OUTPUT PARAMETERS
106
DATA TABLE
FRESHNESS
TIME
FRESHNESS LEVEL
FRESHNESS LEVEL
104
102
100
90
92
FRESHNESS MANAGEMENT SYSTEM
CURRENT FRESHNESS MODULE
FRESHNESS PROJECTION MODULE
MESHING MODULE
94
96
STORAGE DEVICE
HISTORICAL FRESHNESS PARAMETERS
CONSUMER PARAMETERS
80
82
84
NETWORK
60
40
OTHER DATA SOURCES
WEATHER
QUALITY INSPECTIONS
INVENTORY SCANS
MANUALLY ENTERED DATA
42
44
46
48
14
18
20
12
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34
36

FIG. 1

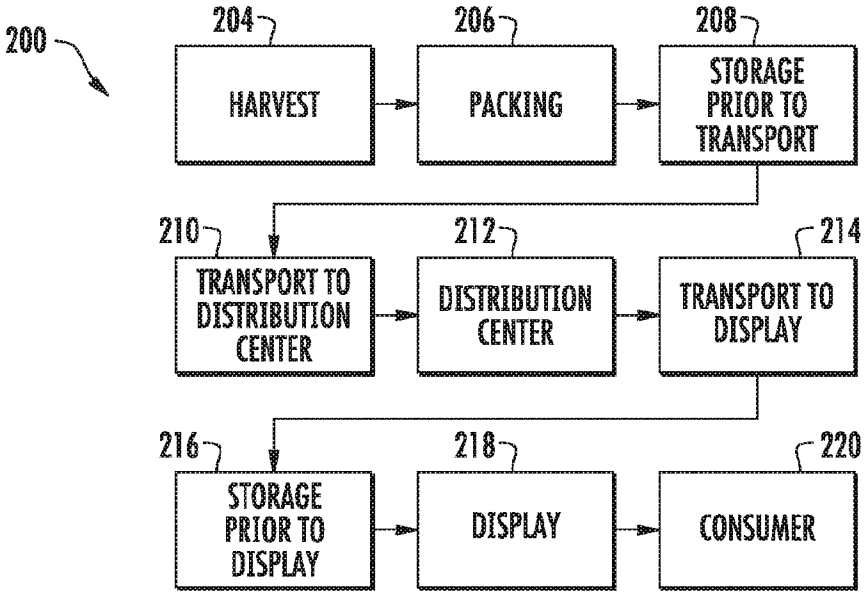
200
204
HARVEST
206
PACKING
208
STORAGE PRIOR TO TRANSPORT
210
TRANSPORT TO DISTRIBUTION CENTER
212
DISTRIBUTION CENTER
214
TRANSPORT TO DISPLAY
216
STORAGE PRIOR TO DISPLAY
218
DISPLAY
220
CONSUMER

FIG. 2

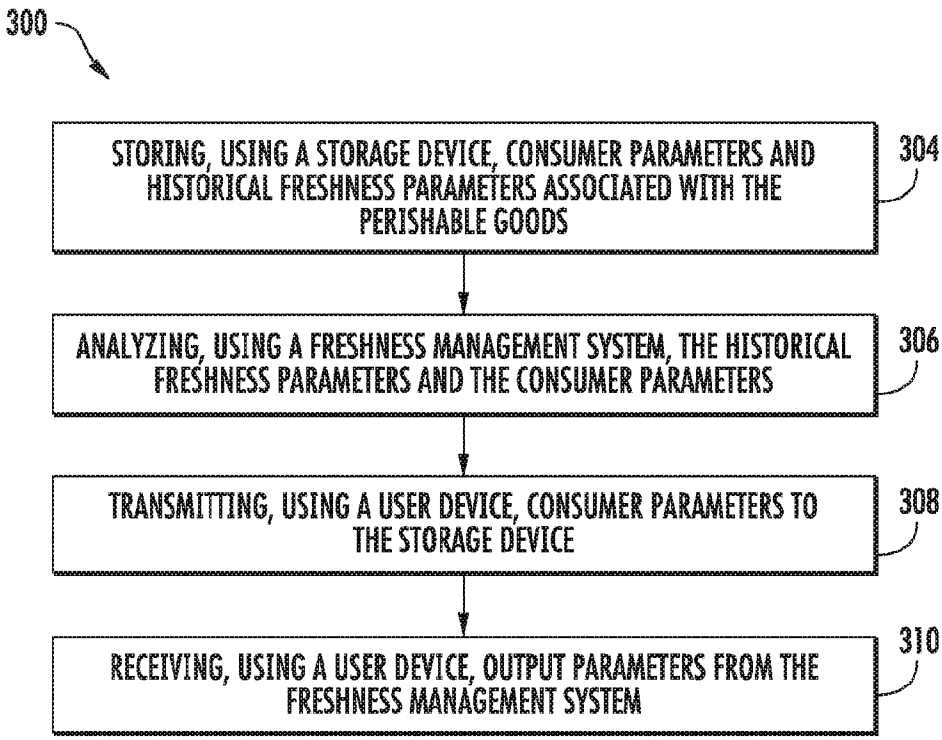
300
STORING, USING A STORAGE DEVICE, CONSUMER PARAMETERS AND HISTORICAL FRESHNESS PARAMETERS ASSOCIATED WITH THE PERISHABLE GOODS
304
ANALYZING, USING A FRESHNESS MANAGEMENT SYSTEM, THE HISTORICAL FRESHNESS PARAMETERS AND THE CONSUMER PARAMETERS
306
TRANSMITTING, USING A USER DEVICE, CONSUMER PARAMETERS TO THE STORAGE DEVICE
308
RECEIVING, USING A USER DEVICE, OUTPUT PARAMETERS FROM THE FRESHNESS MANAGEMENT SYSTEM
310

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/037907

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/178823 A1 (TANAKA RIE [JP] ET AL) 25 June 2015 (2015-06-25) paragraphs [0162], [0165], [0172], [0173], [0207]; figure 1	1-23
X	US 2014/252085 A1 (KIM BYEONG SAM [KR] ET AL) 11 September 2014 (2014-09-11) paragraphs [0017], [0018], [0035]; figures	1,8,16
X	WO 2016/019417 A1 (COLD CHAIN PARTNERS PTY LTD) 11 February 2016 (2016-02-11) pages 33-35	1,8,16

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 September 2017	15/09/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Canköy, Necdet

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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