

Personal Protection Equipment Network (PPE-N)

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FIELD OF THE INVENTION

The present invention generally relates to personal protection equipment. More specifically, the present invention relates to a network system that is designed to help workers stay safe.

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BACKGROUND OF THE INVENTION

A network system that is designed to help workers stay safe is in demand. In many industries, maintaining workers' safety and health is critical because many workplace environments include various risks to employees.

In a work environment, industrial equipment can pose a serious threat to worker safety. Many workers rely on personal protective equipment (PPE) to ensure their safety, and employers strive to provide PPE and other safety equipment to increase protection, lower the risk of workplace injuries, and preclude the associated costs.

Companies have also adopted various rules and regulations to maintain worker safety and health. Some individuals may be required to wear or otherwise use PPE when entering or remaining in work environments. For example, workers in the nuclear industry may be required to wear radiation-protective clothing. Workers in mines, oil refineries, smelting facilities, or industrial painting operations may be required to wear respiratory protective equipment (RPE). However, compiling records pertaining to regulatory compliance is currently performed manually or semi-automatically and is relatively time-consuming. In addition, adherence to predetermined rules and regulations may become an issue in work environments, while any noncompliance may cause unsafe working environments. Thus, there is a need to develop a system to solve the problems.

The present invention is intended to address problems associated with and/or otherwise improve on conventional devices through an innovative network system designed to provide a convenient, effective means to ensure workers' safety while incorporating other problem-solving features.

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SUMMARY

In accordance with the present invention, a PPE-N system is provided. The PPE-N system comprises a registration step and an operation step.

10 The registration step may include a user registration process through which to retrieve user information from users. The operation step may include smart tag readers, smart tags attached to PPE-N components and a hub.

15 The hub can be a software module for authorizations regarding using or maintaining the PPE-N components (e.g., hard hats, safety vests, safety boots, and gloves).

In one embodiment, the hub may be configured to authorize the use of PPE-N components based on a predetermined time and quality of the PPE-N components.

In other embodiment, the hub may be configured to compare signals from the smart tags to help assess the PPE-N component's health.

20 In preferred embodiments, the present invention can determine if the smart tag and the PPE-N component are missing and not being worn or out of the predetermined area.

25 In some other embodiments, the present invention can use RFID technology to network PPE-N components, allowing individual PPE-N components to communicate with each other from very short distances.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustration of one embodiment of the present invention.

FIG. 2 is an illustration of one embodiment showing the registration and operation step of
5 the present invention.

FIG. 3 is an illustration of one embodiment showing PPE-N components arranged in a
star-bus topology with the hub of the present invention.

FIG. 4 is an illustration of one embodiment of the communication between the smart tags
and readers of the present invention.

10 FIG. 5 is an illustration of one embodiment of the communication between the smart tag
readers and the way point of the present invention.

FIG. 6 is an illustration of one embodiment of the communication between the hub and
the way point of the present invention.

FIG. 7 is an illustration of one embodiment of the present invention with the way point
15 attached to a forklift.

FIG. 8 is an illustration showing various PPE-N components of the present invention.

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DETAIL DESCRIPTIONS OF THE INVENTION

All illustrations of the drawings are for the purpose of describing selected versions of the present invention and are not intended to limit the scope of the present invention.

The present invention (Personal Protection Equipment-Network (PPE-N)) **100** provides a system designed to help workers stay safe. The present invention provides a hub **21** that stays in constant communication with PPE components **30** such as hard hats **50**, safety vests **60**, safety boots **70**, and gloves **80** as shown in FIG. **8**, ensuring that workers are using functional, approved equipment.

When entering a work zone, the way-points **23** provided in the present invention makes sure workers have the required PPE-N component **30** for that work area and determines whether the workers are authorized to work in the work zone they are entering, ensuring that workers are protected and allowed to enter only the access areas they are approved to work in.

As shown in FIG. **1**, the present invention provides a PPE-N system **100** that comprises a plurality of processors and a plurality of memories, the latter containing instructions that, when executed by a processor, trigger a registration step **10** and an operation step **20**. The instructions may include routines, programs, objects, data structures, and the like.

The PPE-N system **100** can be implemented in a network environment, which may comprise one or more servers or one or more data stores. In some embodiments, the PPE-N system **100** of the present invention can be loaded onto a user's computing device, which may be communicatively connected to a network.

In other embodiments, the PPE-N system **100** may be deployed on a computing device such that the PPE-N system **100** is configured as a cloud system.

In some other embodiments, the PPE-N system **100** can use Windows Internet Name Service to function as private networks or as sub-domains to larger networks.

Registration Step 10

The registration step 10 may include a user registration process through which to retrieve user information from users, who can be employers or employees.

5 The user registration process may provide a questionnaire, including via a web form, through which users can supply the various data necessary to identify the users.

In one embodiment, the user information may include name, business name, date and time of registration, passwords, and the like.

10 The user registration process may create a user profile 11 using the user information and save the user profile 11 in a storage device that may be included in the PPE-N system 100 of the present invention or that may be communicatively connected to the PPE-N system 100.

In some embodiments, the registration step 10 may include a modification/update process 12 that allows users to modify and update their profiles (user profile 11).

15 In some embodiments, the registration step 10 may include a tag registration process 13 through which to assign a unique PPE-N component 30 name for each piece of personal protection equipment (PPE) that can be used in the working environment.

The name of the PPE-N component 30 can be a combination of numbers and username and the name of the PPE (for example, 123456789-JOHN-SMITH-VEST).

20 The name of the PPE-N component 30 can be transferred to a smart tag 15, which can be any suitable smart tag known in the art. In one exemplary embodiment, the smart tag 15 can be directly attached to the PPE component 30.

The PPE component 30 can include clothing and protective wearable equipment for a single human, such as a hard hat 50, safety boots 70, gloves 80, and safety vest 60, as shown in FIG. 8.

25 In the present invention, PPE-N component 30 pieces can be networked together with smart tags 15 and smart tag readers 22 in various embodiments, as shown in FIGS. 4 to 6.

30 The smart tag 15 can be a data carrier that carries data accessible by suitable methods, such as wireless technology, where the data may include tag identification information, such as an identification number (e.g., serial number), username, and the

name of the equipment. In some embodiments, the data may include any other information that a user needs.

The smart tags **15** may be RFID smart tags **15** that are programmable or rewritable and carry their own internal power source, such as a micro-battery, a thin film battery, or the like. The smart tags **15** may exchange their data information with data acquiring and/or transmitting devices, including, without limitation, readers and/or writers, scanners, and/or data receivers, such as wireless receivers.

The RFID smart tags **15** can be programmed for whatever piece of PPE component **30** they are attached to. For example, the RFID smart tags **15** can be identified as hard-hat-1234567, where the PPE-N component **30** is identified as a hard hat **50**, and the unique hard hat identifier is 1234567. In some embodiments, the smart tags **15** can be passive and do not require power to operate.

In some embodiments, the PPE-N system **100** may include a battery-powered RFID reader that can be programmed to read more than fifty smart tags **15** per second.

Operation Step **20**

The operation step **20** may include a process to scan and monitor PPE components **30** by communicating with the smart tags **15** attached to the PPE components **30**, as shown in FIG. 4 to FIG. 6.

The operation step may include smart tag readers **22** that can be communicatively connected to the smart tags **15** attached to the PPE components **30**.

The data from a smart tag **15** may be acquired by the smart tag readers **22**. A smart tag reader **22** may include a device such as an antenna for communicating with the smart tag **15**. The smart tag reader **22** may be placed in a critical spot to communicate with smart tags **15**.

In some embodiments, the smart tag readers **22** can be installed in a user's computing device.

In some embodiments, the operation step **20** may include a hub **21**. In this case, the smart tag readers **22** may be linked to the hub **21**, as shown in FIG. 4 which is remotely programmable through a network.

The hub **21** can be a software module that may include functionalities such as authorizations regarding using or maintaining the PPE components **30**. For example, if the exposure time or quality of the PPE component **30** in the workplace exceeds a predetermined time/value(s); users with particular profiles should leave the environment or replace the PPE component **30**.

In one embodiment, the hub **21** may be configured to authorize the use of PPE components **30** based on a predetermined time and quality of the PPE components **30** and compare signals from the smart tags **15** to help assess the PPE-N component's **30** health.

In some embodiments, the hub **21** can compare the signal of PPE-N components **30** when they were first joined to the PPE-N system **100** and the current signal level to help assess the PPE-N component's **30** health. When PPE-N component **30** and the smart tags **15** are worn, the hub's ability to read the smart tag **15** can be diminished. Thus, such health checks can ensure proper smart tag **15** -to-smart tag reader **22** communication.

In preferred embodiments, the smart tag reader **22** is constantly scanning. Should the smart tag reader **22** not see a preprogrammed smart tag **15** for more than the allotted time, it will assume the smart tag **15** and the PPE-N component **30** are missing and not being worn or out of the predetermined area (i.e., within the area monitored by the present invention).

After determining there is a missing PPE-N component **30**, the smart tag reader **22** can trigger audible and visual alarms (audio-visual), as well as send a warning to a person responsible for controlling the environment, such as a site controller.

In some embodiments, the smart tag reader **22** can be configured to generate an alarm sound when an object including the PPE-N component **30** without a smart tag **15** enters a predetermined area.

In some embodiments, the present invention can use RFID technology to network PPE-N components **30**, allowing individual PPE-N components **30** to communicate with each other from very short distances.

If PPE-N components **30** cannot communicate with other individual PPE-N components **30**, it will assume they are out of range from each other and something is wrong. A practical example is a worker wearing a safety vest **60** and other PPE-N components **30** that are networked together where the worker removes the safety vest **60**

and walks away. Once the worker removes the safety vest **60**, the worker's other PPE-N component **30** would see that the safety vest **60** is no longer within working range (e.g., 3 ft) and would trigger an alarm. In one example, the PPE-N components **30** can be arranged in a star-bus topology with the hub **21**, as shown in FIG. **3**.

5 In some embodiments, the operation step **20** may include PPE-N sensors known in the art to notify workers when their equipment is failing or has failed. For example, when a PPE component **30** comprising clothing begins to wear and becomes faulty, the hub will see a change in the communications to the clothing and put the clothing in a maintenance mode.

10 In some embodiments, the operation step **20** may include one or more stationary readers (also known as Way Points **23** as shown in FIG. **2**). In this case, the hub **21** of the PPE-N system **100** can communicate with an area-wide Wi-Fi system and with the stationary readers **23** as shown in FIG. **4**. When communicating with stationary readers (way point **23**), the PPE-N system **100** (via the hub **21**) can verify that the person wearing
15 the PPE component **30** has the required equipment present and that the person also has permission to enter the area where the way point **23** is located.

 Such way points **23** can be mobile, capable of communicating in the same manner as stationary way points **23**. As an example, a mobile way point **23** can be attached to a forklift **40**, as shown in FIG. **7**. The mobile way point **23** can verify whether the user has
20 the necessary PPE-N component **30**, training, and permission to operate around or on it. Mobile way points **23** can attach to objects, such as a forklift **40**, using a magnet or a clamp mount.

 The steps and the processes described in connection with the embodiments disclosed herein can be embodied directly in hardware, in a software module executed by
25 a processor, or in a combination of the two. A software module can reside in a memory unit that can include volatile memory, non-volatile memory, and network devices, or other data storage devices now known or later developed for storing information/ data. The volatile memory may be any type of volatile memory including, but not limited to, static or dynamic, random access memory (SRAM or DRAM). The non-volatile memory
30 may be any non-volatile memory including, but not limited to, ROM, EPROM, EEPROM, flash memory, and magnetically or optically readable memory or memory

devices such as compact discs (CDs) or digital video discs (DVDs), magnetic tape, and hard drives.

The computing device may be a laptop computer, a cellular phone, a personal digital assistant (PDA), a tablet computer, and other mobile devices of the type.

5 Communications between components and/or devices in the systems and methods disclosed herein may be unidirectional or bidirectional electronic communication through a wired or wireless configuration or network. For example, one component or device may be wired or networked wirelessly directly or indirectly, through a third party intermediary, over the Internet, or otherwise with another component or device to enable
10 communication between the components or devices. Examples of wireless communications include, but are not limited to, radio frequency (RF), infrared, Bluetooth, wireless local area network (WLAN) (such as WiFi), or wireless network radio, such as a radio capable of communication with a wireless communication network such as a Long Term Evolution (LTE) network, WiMAX network, 3G network, 4G network, and other
15 communication networks of the type. In example embodiments, network can be configured to provide and employ 5G wireless networking features and functionalities.

Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention.

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What is claimed is:

1. A PPE-N system comprising:
 - a plurality of PPE components;
 - a plurality of smart tags attached to the PPE components;
 - 5 a plurality of smart tag readers communicatively connected to the smart tags,
 - wherein the smart tag reader is configured to constantly scan smart tags
 - and, when the smart tag reader cannot detect the smart tag for more than
 - an allotted time, the smart tag reader is configured to trigger audio-visual
 - alarms and send a warning to a predetermined person;
 - 10 a hub communicatively linked to the smart tag readers, the hub is remotely programmable through a network and configured to:
 - authorize the use of PPE components based on a predetermined time and
 - quality of the PPE components;
 - compare signals from the smart tags to help assess the PPE-N component
 - 15 health;
 - generate an alarm sound when an object without the smart tag enters a
 - predetermined area;
 - a plurality of waypoints communicatively connected to the hub, wherein the
 - waypoints are configured to:
 - 20 verify, by communication with the smart tags, that the PPE component
 - attached to the smart tags conforms to requirements of the PPE
 - component;
 - detect the smart tags; and
 - determine whether the PPE component is permitted in the predetermined
 - 25 area.
2. The PPE-N system as claimed in 1, wherein the PPE component is a hard hat.
3. The PPE-N system as claimed in 1, wherein the PPE component is a pair of
- gloves.
4. The PPE-N system as claimed in 1, wherein the PPE component is a safety vest.
- 30 5. The PPE-N system as claimed in 1, wherein the PPE component is a pair of safety
- boots.

6. The PPE-N system as claimed in 1, wherein the plurality of smart tags are RFID smart tags.
7. The PPE-N system as claimed in 1, wherein the way point is mobile way point.
8. The PPE-N system as claimed in 1, wherein the way point is a stationary way point.
9. The PPE-N system as claimed in 1, wherein the PPE-N system further comprises a plurality of sensors configured to notify one or more predetermined people when the PPE-N component fail to satisfy a predetermined condition based on analyzing signals from the sensors.
10. A PPE-N system comprising:
 - a plurality of PPE components;
 - a plurality of smart tags having an antenna and attached to the PPE components;
 - a plurality of smart tag readers communicatively connected to the smart tags, wherein the smart tag reader is configured to constantly scan smart tags and, when the smart tag reader cannot detect the smart tag for more than an allotted time, the smart tag reader is configured to trigger audio-visual alarms and send a warning to a predetermined person;
 - a hub communicatively linked to the smart tag readers, the hub is remotely programmable through a network and configured to:
 - authorize the use of PPE components based on a predetermined time and quality of the PPE components;
 - compare signals from the smart tags to help assess the PPE-N component health;
 - generate an alarm sound when an object without the smart tag enters a predetermined area;
 - a plurality of waypoints communicatively connected to the hub, wherein the waypoints are configured to:
 - verify, by communication with the smart tags, that the PPE component attached to the smart tags conforms to requirements of the PPE component;
 - detect the smart tags; and

determine whether the PPE component is permitted in the predetermined area.

11. The PPE-N system as claimed in 10, wherein the PPE component is a hard hat.
12. The PPE-N system as claimed in 10, wherein the PPE component is a pair of
5 gloves.
13. The PPE-N system as claimed in 10, wherein the PPE component is a safety vest.
14. The PPE-N system as claimed in 10, wherein the PPE component is a pair of
safety boots.
15. The PPE-N system as claimed in 10, wherein the plurality of smart tags are RFID
10 smart tags.
16. The PPE-N system as claimed in 10, wherein the way point is mobile way point.
17. The PPE-N system as claimed in 10, wherein the way point is a stationary way
point.
18. The PPE-N system as claimed in 10, wherein the PPE-N system further comprises
15 a plurality of sensors configured to notify one or more predetermined people
when the PPE-N component fail to satisfy a predetermined condition based on
analyzing signals from the sensors.
19. A PPE-N system comprising:
a plurality of PPE components;
20 a plurality of smart tags installed in a user's computing device and
communicatively connected to the PPE components;
a plurality of smart tag readers communicatively connected to the smart tags,
wherein the smart tag reader is configured to constantly scan smart tags
and, when the smart tag reader cannot detect the smart tag for more than
25 an allotted time, the smart tag reader is configured to trigger audio-visual
alarms and send a warning to a predetermined person;
a hub communicatively linked to the smart tag readers, the hub is remotely
programmable through a network and configured to:
authorize the use of PPE components based on a predetermined time and
30 quality of the PPE components;

- compare signals from the smart tags to help assess the PPE-N component health;
- generate an alarm sound when an object without the smart tag enters a predetermined area;
- 5 a plurality of waypoints communicatively connected to the hub, wherein the waypoints are configured to:
- verify, by communication with the smart tags, that the PPE component attached to the smart tags conforms to requirements of the PPE component;
- 10 detect the smart tags; and
- determine whether the PPE component is permitted in the predetermined area.
20. The PPE-N system as claimed in 19, wherein the PPE component is a hard hat.
21. The PPE-N system as claimed in 19, wherein the PPE component is a pair of
- 15 gloves.
22. The PPE-N system as claimed in 19, wherein the PPE component is a safety vest.
23. The PPE-N system as claimed in 19, wherein the PPE component is a pair of safety boots.
24. The PPE-N system as claimed in 19, wherein the plurality of smart tags are RFID
- 20 smart tags.
25. The PPE-N system as claimed in 19, wherein the way point is mobile way point.
26. The PPE-N system as claimed in 19, wherein the way point is a stationary way point.
27. The PPE-N system as claimed in 19, wherein the PPE-N system further comprises
- 25 a plurality of sensors configured to notify one or more predetermined people when the PPE-N component fail to satisfy a predetermined condition based on analyzing signals from the sensors.

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