FORM 2

THE PATENT ACT 1970

(39 of 1970)

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The Patents Rules, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

1. TITLE OF THE INVENTION:

"IOT INTEGRATED SYSTEM FOR GAS LEAK DETECTION AND THREAT ZONE IDENTIFICATION AND METHOD EMPLOYED THEREOF"

2. APPLICANTS:

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3. PREAMBLE TO THE DESCRIPTION

The following specification particularly describes the invention and the manner in which it is to be performed.

4. DESCRIPTION

TECHNICAL FIELD

[001] The present disclosure generally relates to the field of industrial safety for example oil and gas handling industries or refineries. More particularly, the present disclosure relates to an IoT-integrated system for gas leak detection and threat zone identification and method employed thereof. Additionally, the present disclosure focuses on the identification and management of threat zones, including those associated with the potential for explosion.

BACKGROUND

[002] Chemical and gas refineries play a crucial role in various industries worldwide, providing essential products for numerous applications. However, these facilities pose significant safety risks, particularly in the event of explosions, leading to the release of harmful gases that can endanger human lives and cause widespread devastation. Tragic incidents such as the Bhopal gas tragedy in 1984 and the gas leak in Visakhapatnam in 2020 serve as stark reminders of the catastrophic consequences associated with such accidents. In these instances, thousands of lives were lost or affected, underscoring the urgent need for robust safety measures and efficient alert systems in industrial settings.

[003] Despite the inherent risks, many companies struggle to adhere to stringent security norms effectively, resulting in inadequate safety protocols and systems. The prevailing alert systems, typically comprising sirens deployed within the premises of refineries, present several limitations that compromise their effectiveness. These sirens, activated in the event of a gas explosion, emit audible alerts but are confined to limited areas, failing to provide comprehensive coverage. Moreover, their indiscriminate activation across all areas surrounding the industry, regardless of the presence of actual threat zones, contributes to inefficiency and unnecessary alarm.

[004] Furthermore, the existing alert systems lack the capability to measure crucial parameters of the air and estimate the extent of gas leakage into the atmosphere following an explosion. This deficiency hampers the ability to accurately assess and respond to the situation, exacerbating the potential impact on human lives and the environment. In the aftermath of a refinery explosion, the absence of precise information regarding the affected areas poses significant challenges in implementing timely and targeted evacuation measures. Without adequate awareness of the direction of gas dispersion, individuals remain vulnerable to severe harm, as demonstrated by past tragedies.

[005] Therefore, there exists a critical need for an innovative solution that addresses the shortcomings of current alert systems and enhances the ability to detect and manage threat zones associated with gas explosions in industrial environments. Such a solution must incorporate advanced technologies to enable real-time monitoring, accurate assessment of gas dispersion, and timely dissemination of alerts to facilitate swift and effective response measures, ultimately safeguarding lives and minimizing the impact of refinery accidents.

[006] In the light of the aforementioned discussion, there exists a need for a certain system with novel methodologies that would overcome the above-mentioned disadvantages.

SUMMARY

[007] The following presents a simplified summary of the disclosure in order to provide a basic understanding to the reader. This summary is not an extensive overview of the disclosure and it does not identify key/critical elements of the invention or delineate the scope of the invention. Its sole purpose is to present some concepts disclosed herein in a simplified form as a prelude to the more detailed description that is presented later.

[008] Exemplary embodiments of the present disclosure are directed towards an IoT-integrated system for gas leak detection and threat zone identification and method employed thereof.

[009] An objective of the present disclosure is directed towards a system that integrates Machine Learning, Artificial Intelligence, and Internet of Things technologies to efficiently detect threat zones and provide real-time alerts in industrial environments.

[0010] Another objective of the present disclosure is directed towards a system that utilizes gas sensors to identify the presence of poisonous gases in the air, enabling rapid detection of gas leaks.

[0011] Another objective of the present disclosure is directed towards a system that incorporates advanced algorithms to identify the direction and extent of gas leakage, utilizing factors such as wind speed and direction to delineate dangerous zones.

[0012] Another objective of the present disclosure is directed towards a system that implements auditory alarms, mobile notifications, and broadcast messages to alert individuals and emergency services of potential hazards, facilitating timely evacuation and response efforts.

[0013] Another objective of the present disclosure is directed towards a system that identifies the direction of gas leakage in a radius manner and gives alerts to people and emergency services through mobiles and alarms

[0014] Another objective of the present disclosure is directed towards a system that categorizes alerts into three levels (red, orange, and yellow) based on severity, enabling targeted evacuation measures and informed decision-making.

[0015] Another objective of the present disclosure is directed towards a system that overcomes the limitations of existing systems by deploying alarms in surrounding areas beyond the premises of industrial facilities, ensuring broader coverage and enhanced safety.

[0016] Another objective of the present disclosure is directed towards a system that automatically activates alarms in proximity to gas leaks, prioritizing alert levels (e.g., red, orange, yellow) based on distance from the source and direction of gas dispersion.

[0017] Another objective of the present disclosure is directed towards a system that utilizes parameters such as wind direction, speed, and temperature to accurately measure the radius of gas spread and identify threat zones with high precision.

[0018] Another objective of the present disclosure is directed towards a system that facilitates efficient evacuation by distinguishing safe zones (green) from threat zones (red, orange, yellow) and providing tailored alerts to individuals based on their proximity to the hazard.

[0019] Another objective of the present disclosure is directed towards a system that continuously monitors and assesses the severity of gas leaks and threat zones in real time, allowing for dynamic adjustments in alert levels and response strategies.

[0020] Another objective of the present disclosure is directed towards a system that adapts response actions based on evolving environmental conditions and gas dispersion patterns, ensuring optimal safety measures tailored to the specific situation.

[0021] Another objective of the present disclosure is directed towards a system that establishes seamless communication channels with nearby emergency services, enabling swift coordination and response in the event of gas leaks or explosions.

[0022] Another objective of the present disclosure is directed towards a system that utilizes data analytics to analyze historical incident data, identify trends, and generate comprehensive reports for post-incident analysis and improvement of safety protocols.

[0023] Another objective of the present disclosure is directed towards a system that enables remote monitoring and control through centralized platforms, allowing operators to access real-time data, issue alerts, and initiate emergency protocols from anywhere.

[0024] Another objective of the present disclosure is directed towards a system that is designed for scalability to accommodate varying industrial settings and operational requirements, with flexible configuration options to suit specific needs and environments.

[0025] Another objective of the present disclosure is directed towards a system that incorporates redundant systems and fail-safe mechanisms to ensure continuous operation and reliability, minimizing the risk of system failures or false alarms.

[0026] Another objective of the present disclosure is directed towards a system that complies with industry standards and regulatory requirements for industrial safety, providing a comprehensive solution that meets or exceeds established guidelines and protocols.

[0027] Another objective of the present disclosure is directed towards a system that features user-friendly interfaces and intuitive controls for ease of use by operators and emergency responders, facilitating rapid decision-making and response actions.

[0028] Another objective of the present disclosure is directed towards a system that emphasizes a culture of continuous improvement through feedback mechanisms, user training, and system updates to enhance performance, usability, and effectiveness over time.

[0029] According to an exemplary aspect of the present disclosure, a plurality of gas sensors strategically placed throughout an industrial environment to monitor air quality and detect harmful gases, whereby the plurality of gas sensors configured to transfer the air quality and harmful gases real-time data to a first computing device over a network.

[0030] According to another exemplary aspect of the present disclosure, the first computing device comprises a gas exposure monitoring module, wherein the gas exposure monitoring module configured to receive the real-time data of air quality and harmful gases from the plurality of gas sensors, the gas exposure monitoring module configured to analyze the real-time data of air quality and harmful gases to detect the presence of harmful gases and identify potential gas leak incidents using environmental factors wind speed and direction with temperature to identify and delineate threat zones within the industrial environment, the gas exposure monitoring module configured to categorize threat zones into different levels of severity based on the concentration of harmful gases.

[0031] According to another exemplary aspect of the present disclosure, the gas exposure monitoring module configured to send alerts to individuals and emergency services through auditory, and visual alarms and broadcast messages based on the different levels of the threat zones.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] In the following, numerous specific details are set forth to provide a thorough description of various embodiments. Certain embodiments may be practiced without these specific details or with some variations in detail. In some instances, certain features are described in less detail so as not to obscure other aspects. The level of detail associated with each of the elements or features should not be construed to qualify the novelty or importance of one feature over the others.

[0033] FIG. 1 is a block diagram depicting a schematic representation of a system for gas leak detection and threat zone identification, in accordance with one or more exemplary embodiments.

[0034] FIG. 2 is a block diagram depicting an embodiment of the gas exposure monitoring module 114 on the first computing device, in accordance with one or more exemplary embodiments.

[0035] FIG. 3 is an example embodiment of the gas leak detection and threat zone identification system, in accordance with one or more exemplary embodiments.

[0036] Fig 4 is an example diagram depicting the threat zones near gas refineries, in accordance with one or more exemplary embodiments.

[0037] FIG. 5 is a flow diagram depicting a method for gas leak detection and threat zone identification, in accordance with one or more exemplary embodiments.

[0038] FIG. 6 is a block diagram illustrating the details of a digital processing system in which various aspects of the present disclosure are operative by execution of appropriate software instructions.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

[0039] It is to be understood that the present disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The present disclosure is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

[0040] The use of “including”, “comprising” or “having” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The terms “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items. Further, the use of terms “first”, “second”, and “third”, and the like, herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another.

[0041] Referring to FIG. 1 is a block diagram depicting a schematic representation of a system for gas leak detection and threat zone identification, in accordance with one or more exemplary embodiments. The system 100 includes a first computing device 102, a network 104, gas sensors 106, a second computing device 108, a third computing device 110, auditory and visual alarms 112, and a gas exposure monitoring module 114.

[0042] The first computing device 103 may serve as the central processing unit responsible for coordinating activities and processing incoming data. The first computing device 102 may receive data from gas sensors 106 strategically deployed throughout the industrial environment. The gas sensors 106 may be configured to continuously monitor air quality, detect the presence of harmful gases, and provide real-time data to the first computing device 102. This data is crucial for identifying gas leak incidents and determining the severity and location of threat zones within the facility. The gas sensors 106 may be configured to transfer the real-time data to the first computing device 102 over a network. The real-time data may include but not limited to air quality, harmful gases present in the air, and the like. The computing devices 102, 108, and 110 may include, but are not limited to, a personal digital assistant, smartphones, personal computers, a mobile station, computing tablets, a handheld device, an internet enabled calling device, an internet enabled calling software, a telephone, a mobile phone, a digital processing system, and so forth.

[0043] Although the first computing device 102 is shown in FIG. 1, an embodiment of the system 100 may support any number of computing devices. The first computing device 102 supported by the system 100 is realized as a computer-implemented or computer-based device having the hardware or firmware, software, and/or processing logic needed to carry out the computer-implemented methodologies described in more detail herein. The network 104 may include, but not limited to, an Internet of things (IoT network devices), an Ethernet, a wireless local area network (WLAN), or a wide area network (WAN), a Bluetooth low energy network, a ZigBee network, a WIFI communication network e.g., the wireless high speed internet, or a combination of networks, a cellular service such as a 4G (e.g., LTE, mobile WiMAX) or 5G cellular data service, a RFID module, a NFC module, wired cables, such as the world-wide-web based Internet, or other types of networks may include Transport Control Protocol/Internet Protocol (TCP/IP) or device addresses (e.g. network-based MAC addresses, or those provided in a proprietary networking protocol, such as Modbus TCP, or by using appropriate data feeds to obtain data from various web services, including retrieving XML data from an HTTP address, then traversing the

XML for a particular node) and so forth without limiting the scope of the present disclosure.

[0044] The second computing device 108, representing emergency services such as police stations, hospitals, and rescue teams, is interconnected via network 104. This allows seamless communication and data exchange between the system and the emergency services, facilitating prompt response and assistance in the event of a gas leak or threat zone identification. The third computing device 110 may represent individuals living close to the gas industry. This device is also interconnected via network 104 and receives alerts and notifications from the system to prompt timely evacuation and ensure their safety. The first computing device 102 may include the gas exposure monitoring module 114. The gas exposure monitoring module 114 enhances the capabilities of the system by providing detailed insights into gas concentration levels and exposure risks. The gas exposure monitoring module 114 may analyze data from the gas sensors 106 and generate comprehensive reports to help stakeholders assess the situation and implement effective safety measures. The auditory and visual alarms 112 may activated in the vicinity to alert individuals of potential hazards, ensuring timely evacuation and response efforts. The auditory and visual alarms 112 may provide crucial warnings to workers and residents, prompting them to take appropriate action in the event of a gas leak or threat zone identification.

[0045] Referring to FIG. 2 is a block diagram depicting an embodiment of the gas exposure monitoring module 114 on the first computing device, in accordance with one or more exemplary embodiments. The gas exposure monitoring module 114 includes a sensor data acquisition module 202, a gas detection module 204, a threat zone identification module 206, a threat zone classification module 208, and an alerts generating module 210. The sensor data acquisition module 202 may be configured to collect real-time data from gas sensors 106 deployed throughout the industrial environment. The sensor data acquisition module 202 interfaces with the sensors, retrieves data, and organizes it for further processing. The gas detection module 204 may analyze the collected sensor data to detect the presence of harmful gases and identify potential gas leak incidents. The gas detection module 204 may utilize advanced algorithms to interpret sensor readings and identify abnormal patterns indicative of gas leaks. The threat zone identification module 206 may utilize data from the gas detection module 204, along with environmental factors such as wind speed and direction, to identify and delineate threat zones within the industrial facility. The threat zone identification module 206 may be configured to determine the extent and severity of gas dispersion and define the boundaries of hazardous areas. The threat zone classification module 208 may be configured to categorize threat zones into different levels of severity, such as red, orange, and yellow, based on the concentration of harmful gases and the potential risk to individuals and infrastructure. The alerts generating module 210 may be configured to generate alerts and notifications to alert individuals and emergency services of potential hazards. The alerts generating module 210 may be configured to activate auditory and visual alarms 112, broadcast messages, and send mobile notifications to the second computing device 108 and third computing device 110 to prompt timely evacuation and response efforts in the event of a gas leak or threat zone identification.

[0046] Referring to FIG. 3 is an example embodiment of the gas leak detection and threat zone identification system, in accordance with one or more exemplary embodiments. The first computing device 103 may serve as the central processing unit responsible for coordinating activities and processing incoming data. The first computing device 102 may receive data from gas sensors 106 strategically deployed throughout the industrial environment. The gas sensors 106 may be configured to continuously monitor air quality, detect the presence of harmful gases, and provide real-time data to the first computing device 102. This data is crucial for identifying gas leak incidents and determining the severity and location of threat zones within the facility. The gas sensors 106 may be configured to transfer the real-time data to the first computing device 102 over a network. The real-time data may include but not limited to air quality, harmful gases present in the air, and the like. The computing devices 102, 108, and 110 may include, but are not limited to, a personal digital assistant, smartphones, personal computers, a mobile station, computing tablets, a handheld device, an internet enabled calling device, an internet enabled calling software, a telephone, a mobile phone, a digital processing system, and so forth. The second computing device 108, representing emergency services such as police stations, hospitals, and rescue teams, is interconnected via network 104. This allows seamless communication and data exchange between the system and the emergency services, facilitating prompt response and assistance in the event of a gas leak or threat zone identification. The third computing device 110 may represent individuals living close to the gas industry. This device is also interconnected via network 104 and receives alerts and notifications from the system to prompt timely evacuation and ensure their safety. The first computing device 102 may include the gas exposure monitoring module 114. The gas exposure monitoring module 114 enhances the capabilities of the system by providing detailed insights into gas concentration levels and exposure risks. The gas exposure monitoring module 114 may analyze data from the gas sensors 106 and generate comprehensive reports to help stakeholders assess the situation and implement effective safety measures. The auditory and visual alarms 112 may activated in the vicinity to alert individuals of potential hazards, ensuring timely evacuation and response efforts. The auditory and visual alarms 112 may provide crucial warnings to workers and residents, prompting them to take appropriate action in the event of a gas leak or threat zone identification. The sensor data acquisition module 202 may be configured to collect real-time data from gas sensors 106 deployed throughout the industrial environment. The sensor data acquisition module 202 interfaces with the sensors, retrieves data, and organizes it for further processing. The gas detection module 204 may analyze the collected sensor data to detect the presence of harmful gases and identify potential gas leak incidents. The gas detection module 204 may utilize advanced algorithms to interpret sensor readings and identify abnormal patterns indicative of gas leaks. The threat zone identification module 206 may utilize data from the gas detection module 204, along with environmental factors such as wind speed and direction, to identify and delineate threat zones within the industrial facility. The threat zone identification module 206 may be configured to determine the extent and severity of gas dispersion and define the boundaries of hazardous areas. The threat zone classification module 208 may be configured to categorize threat zones into different levels of severity, such as red, orange, and yellow, based on the concentration of harmful gases and the potential risk to individuals and infrastructure. The alerts generating module 210 may be configured to generate alerts and notifications to alert individuals and emergency services of potential hazards. The alerts generating module 210 may be configured to activate auditory and visual alarms 112, broadcast messages, and send mobile notifications to the second computing device 108 and third computing device 110 to prompt timely evacuation and response efforts in the event of a gas leak or threat zone identification.

[0047] Referring to Fig 4 is an example diagram depicting the threat zones near gas refineries, in accordance with one or more exemplary embodiments. The diagram includes Gas and chemical refinery 402, threat zone 1 (Red zone) 404, threat zone 2 (Orange zone) 406, threat zone 3 (yellow zone) 408, green zone 410, 412a to 412l are auditory and visual alarms. The Gas and chemical refinery 402, representing the industrial facility where gas leakage incidents may occur. The threat zones are delineated into distinct regions based on severity levels. Threat zone 1 (Red zone) 404 represents the area closest to the gas refinery, where the concentration of harmful gases is the highest, and immediate evacuation is required. Threat zone 2 (Orange zone) 406 extends further from the refinery, indicating a moderate risk level, requiring precautionary measures and readiness for evacuation. Threat zone 3 (Yellow zone) 408 encompasses areas beyond the orange zone, where the risk level is lower but still warrants caution and preparedness. The green zone 410 indicates safe areas where the concentration of harmful gases is minimal or non-existent, ensuring the safety of individuals residing or working in these areas. Additionally, auditory and visual alarms 412a to 412l are strategically placed throughout the threat zones to alert individuals of potential hazards. These alarms provide crucial warnings, prompting immediate action and ensuring the safety of personnel in the event of a gas leakage incident.

[0048] Referring to FIG. 5 is a flow diagram depicting a method for gas leak detection and threat zone identification, in accordance with one or more exemplary embodiments. The method 500 may be carried out in the context of the details of FIG. 1, FIG. 2, FIG. 3 and FIG. 4. However, the method 500 may also be carried out in any desired environment. Further, the aforementioned definitions may equally apply to the description below.

[0049] The method commences at step 502, placing a plurality of gas sensors strategically throughout an industrial environment to monitor air quality and detect harmful gases in real time. Thereafter at step 504, transferring real-time data of air quality and harmful gases from the plurality of gas sensors to a first computing device over a network. Thereafter at step 506, analyzing the real-time data of air quality and harmful gases received from the plurality of gas sensors using a gas exposure monitoring module enabled on the first computing device. Thereafter at step 508, detecting the presence of harmful gases and identifying potential gas leak incidents based on the analyzed real-time data using environmental factors to identify and delineate threat zones within the industrial environment. Thereafter at step 510, categorizing the identified threat zones into different levels of severity based on the concentration of harmful gases. Thereafter at step 512, sending alerts to individuals and emergency services through auditory, and visual alarms, and broadcast messages based on the severity levels of the identified threat zones.

[0050] Referring to FIG. 6 is a block diagram 600 illustrating the details of a digital processing system 600 in which various aspects of the present disclosure are operative by execution of appropriate software instructions. The Digital processing system 600 may correspond to the computing devices (or any other system in which the various features disclosed above can be implemented).

[0051] Digital processing system 600 may contain one or more processors such as a central processing unit (CPU) 610, random access memory (RAM) 620, secondary memory 630, graphics controller 660, display unit 670, network interface 680, and input interface 690. All the components except display unit 670 may communicate with each other over communication path 650, which may contain several buses as is well known in the relevant arts. The components of Figure 6 are described below in further detail.

[0052] CPU 610 may execute instructions stored in RAM 620 to provide several features of the present disclosure. CPU 610 may contain multiple processing units, with each processing unit potentially being designed for a specific task. Alternatively, CPU 610 may contain only a single general-purpose processing unit.

[0053] RAM 620 may receive instructions from secondary memory 630 using communication path 650. RAM 620 is shown currently containing software instructions, such as those used in threads and stacks, constituting shared environment 625 and/or user programs 626. Shared environment 625 includes operating systems, device drivers, virtual machines, etc., which provide a (common) run time environment for execution of user programs 626.

[0054] Graphics controller 660 generates display signals (e.g., in RGB format) to display unit 670 based on data/instructions received from CPU 610. Display unit 670 contains a display screen to display the images defined by the display signals. Input interface 690 may correspond to a keyboard and a pointing device (e.g., touch-pad, mouse) and may be used to provide inputs. Network interface 680 provides connectivity to a network (e.g., using Internet Protocol), and may be used to communicate with other systems (such as those shown in Figure 1) connected to the network 104.

[0055] Secondary memory 630 may contain hard drive 635, flash memory 636, and removable storage drive 637. Secondary memory 630 may store the data software instructions (e.g., for performing the actions noted above with respect to the Figures), which enable digital processing system 600 to provide several features in accordance with the present disclosure.

[0056] Some or all of the data and instructions may be provided on removable storage unit 640, and the data and instructions may be read and provided by removable storage drive 637 to CPU 610. Floppy drive, magnetic tape drive, CD-ROM drive, DVD Drive, Flash memory, removable memory chip (PCMCIA Card, EEPROM) are examples of such removable storage drive 637.

[0057] Removable storage unit 640 may be implemented using medium and storage format compatible with removable storage drive 637 such that removable storage drive 637 can read the data and instructions. Thus, removable storage unit 640 includes a computer readable (storage) medium having stored therein computer software and/or data. However, the computer (or machine, in general) readable medium can be in other forms (e.g., non-removable, random access, etc.).

[0058] In this document, the term "computer program product" is used to generally refer to removable storage unit 640 or hard disk installed in hard drive 635. These computer program products are means for providing software to digital processing system 600. CPU 610 may retrieve the software instructions, and execute the instructions to provide various features of the present disclosure described above.

[0059] The term “storage media/medium” as used herein refers to any non-transitory media that store data and/or instructions that cause a machine to operate in a specific fashion. Such storage media may comprise non-volatile media and/or volatile media. Non-volatile media includes, for example, optical disks, magnetic disks, or solid-state drives, such as storage memory 630. Volatile media includes dynamic memory, such as RAM 620. Common forms of storage media include, for example, a floppy disk, a flexible disk, hard disk, solid-state drive, magnetic tape, or any other magnetic data storage medium, a CD-ROM, any other optical data storage medium, any physical medium with patterns of holes, a RAM, a PROM, and EPROM, a FLASH-EPROM, NVRAM, any other memory chip or cartridge.

[0060] Storage media is distinct from but may be used in conjunction with transmission media. Transmission media participates in transferring information between storage media. For example, transmission media includes coaxial cables, copper wire and fiber optics, including the wires that comprise bus (communication path) 650. Transmission media can also take the form of acoustic or light waves, such as those generated during radio-wave and infra-red data communications.

[0061] Reference throughout this specification to “one embodiment”, “an embodiment”, or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. Thus, appearances of the phrases “in one embodiment”, “in an embodiment” and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

[0062] Although the present disclosure has been described in terms of certain preferred embodiments and illustrations thereof, other embodiments and modifications to preferred embodiments may be possible that are within the principles of the invention. The above descriptions and figures are therefore to be regarded as illustrative and not restrictive.

[0063] Thus the scope of the present disclosure is defined by the appended claims and includes both combinations and sub-combinations of the various features described hereinabove as well as variations and modifications thereof, which would occur to persons skilled in the art upon reading the foregoing description.

5. CLAIMS;

We Claim

1. A system for gas leak detection and threat zone identification, comprising

a plurality of gas sensors strategically placed throughout an industrial environment to monitor air quality and detect harmful gases, whereby the plurality of gas sensors configured to transfer the air quality and harmful gases real-time data to a first computing device over a network;

the first computing device comprises a gas exposure monitoring module, wherein the gas exposure monitoring module configured to receive the real-time data of air quality and harmful gases from the plurality of gas sensors, the gas exposure monitoring module configured to analyze the real-time data of air quality and harmful gases to detect the presence of harmful gases and identify potential gas leak incidents using environmental factors wind speed and direction with temperature to identify and delineate threat zones within the industrial environment, the gas exposure monitoring module configured to categorize threat zones into different levels of severity based on the concentration of harmful gases; and

the gas exposure monitoring module configured to send alerts to individuals and emergency services through auditory, and visual alarms and broadcast messages based on the different levels of the threat zones.

2. The system as claimed in claim 1, wherein the gas exposure monitoring module comprises a sensor data acquisition module is configured to collect real-time data from the plurality of gas sensors.

3. The system as claimed in claim 1, wherein the gas exposure monitoring module comprises a gas detection module is configured to analyze the collected sensor data to detect the presence of harmful gases and identify potential gas leak incidents.

4. The system as claimed in claim 1, wherein the gas exposure monitoring module comprises a threat zone identification module configured to identify and delineate threat zones within the industrial facility.

5. The system as claimed in claim 1, wherein the gas exposure monitoring module comprises a threat zone classification module is configured to categorize threat zones into different levels of severity, such as red, orange, and yellow, based on the concentration of harmful gases and the potential risk to individuals and infrastructure.

6. The system as claimed in claim 1, wherein the gas exposure monitoring module comprises an alerts generating module is configured to generate alerts and notifications to alert individuals and emergency services of potential hazards.

7. The system as claimed in claim 1, wherein the alert system includes visual flashing lights in addition to auditory alarms.

8. The system as claimed in claim 6, wherein the alerts generating module is configured is configured to send alerts to nearby mobile devices and emergency services simultaneously.

9. The system as claimed in claim 6, wherein the alerts generating module is configured to activate auditory and visual alarms, broadcast messages, and send mobile notifications to a second computing device and a third computing device.

10. A method for gas leak detection and threat zone identification, comprising:

placing a plurality of gas sensors strategically throughout an industrial environment to monitor air quality and detect harmful gases in real time;

transferring real-time data of air quality and harmful gases from the plurality of gas sensors to a first computing device over a network;

analyzing the real-time data of air quality and harmful gases received from the plurality of gas sensors using a gas exposure monitoring module enabled on the first computing device;

detecting the presence of harmful gases and identifying potential gas leak incidents based on the analyzed real-time data using environmental factors to identify and delineate threat zones within the industrial environment;

categorizing the identified threat zones into different levels of severity based on the concentration of harmful gases; and

sending alerts to individuals and emergency services through auditory, and visual alarms, and broadcast messages based on the severity levels of the identified threat zones.

6. DATE AND SIGNATURE:

Dated this April 16, 2024

Authorized Patent Agent Signature:

Authorized Patent Agent Name: **PUTTA GANESH (IN/PA-2933)**

7. ABSTRACT

"IOT INTEGRATED SYSTEM FOR GAS LEAK DETECTION AND THREAT ZONE IDENTIFICATION AND METHOD EMPLOYED THEREOF"

Exemplary embodiments of the present disclosure are directed towards an iot integrated system for gas leak detection and threat zone identification and method employed thereof, comprising: a plurality of gas sensors configured to transfer air quality and harmful gases real-time data to first computing device over a network. First computing device comprises gas exposure monitoring module configured to analyze the real-time data of air quality and harmful gases to detect the presence of harmful gases and identify potential gas leak incidents using environmental factors wind speed and direction with temperature to identify and delineate threat zones within the industrial environment, the gas exposure monitoring module configured to categorize threat zones into different levels of severity based on the concentration of harmful gases. The gas exposure monitoring module configured to send alerts to individuals and emergency services through auditory, and visual alarms and broadcast messages based on the different levels of the threat zones.

Fig. 1