WEARABLE FIRE & TOXIC GAS DETECTOR

M. Vimal Raj[1], M. Sivamani[2], R. Ashwin[3], T.Thangavel[4]

[123]UG student,Depatment of Safety and fire engineering Paavai Engineering College,Namakkal

[4]Assistant Professor, Mechanical Engineering, Paavai Engineering College

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ABSTRACT

Safety plays a major role in today's world and it is necessary that good safety systems are to be implemented in places of education and work. This work modifies the existing safety model installed in industries and this system also be used in homes and offices.The main objective of the work Is designing microcontroller based toxic gas detecting and alerting system. The hazardous gases like LPG and propane were sensed and displayed each and every second in the LCD display.If these gases exceed the normallevel then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the GSM. The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation.

Key Words; *Detector, Fire Detection, Sensor, Alram Safety*

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1.INTRODUCTION:

Fireguard is a revolutionary wearable fire detection device aimed at transforming personal fire safety. In contrast to conventional fire alarms that are fixed in place and often limited to alerting occupants within a confined area, Fireguard provides a mobile, real-time solution. Equipped with

advanced sensors capable of detecting heat, smoke, and toxic gases like carbon monoxide, the device offers immediate alerts through vibrations, audible alarms, and mobile notifications. This ensures that users are quickly informed of potential dangers, even if they are asleep, working in high-risk environments, or situated far from traditional alarm systems. Compact, lightweight, and easy to wear on the wrist, belt, or clothing, Fireguard is especially valuable for workers in hazardous industries, elderly individuals living alone, and families with young children. By combining portability with smart technology, Fireguard empowers individuals to take proactive steps in fire emergencies, ultimately bridging the gap between awareness and action.

This innovative wearable technology aims to:

1. Detect potential fire hazards before they spread
2. Provide personalized alerts and warnings
3. Enhance situational awareness in high-risk environments
4. Facilitate swift emergency response and evacuation

By leveraging advanced sensor technologies and wearable design, FireGuard offers a discreet, user-friendly solution for individuals seeking enhanced fire safety and peace of mind.

2.LITERATURE SURVEY:

As smartphone penetration saturates, we are witnessing a new trend in personal mobile devices -wearable mobile devices or simply wearables as it is often called. Wearables come in many different forms and flavours targeting different accessories and clothing that people wear. Although small in size, they are often expected to continuously sense, collect, and upload various physiological data to improve quality of life. These requirements put significant demand on improving communication security and reducing power consumption of the system, fuelling new research in these areas. In this article, we first provide a comprehensive survey and classification of commercially available wearables and research prototypes. We then examine the communication security issues facing the popular wearables followed by a survey of solutions studied in the literature.We also categorise and explain the techniques for improving the power efficiency of

wearables. Next, we survey the research literature in wearable computing.We conclude with future directions in wearable market and research.

3.OBJECTIVE AND METHODOLOGY:

The primary objective of the Wearable Fire Detector (FireGuard) is to design a compact, user-friendly device that:

- Accurately detects heat, smoke, and toxic gases in real-time
- Provides immediate alerts and warnings to the user
- Enhances situational awareness and facilitates swift emergency response
- Offers a reliable, wearable solution for fire safety in various environments

4.Research and Development

- Literature review: Study existing fire detection technologies, wearable devices, and Sensor technologies.
- User research: Conduct surveys, interviews, and focus groups to understand user needs And preferences.
- Sensor selection: Evaluate and select suitable sensors for heat, smoke, and toxic gas Detection. *Device Design and Development*
- Concept design: Sketch and prototype device designs, considering wearability, comfort, And aesthetics.
- Sensor integration: Integrate selected sensors into the device, ensuring accurate Detection and reliability.
- Microcontroller selection: Choose a suitable microcontroller for sensor data processing And alert generation.
- Alert system design: Design a clear and effective alert system, including visual, auditory, And vibrational notification

5.PURPOSE TECHNIQUES :

Fire & Gas systems are designed to monitor environmental conditions and detect those variations that can be associated with an incipient fire or gas leakage. Most of the time the

F&G system is formed by one or more control panels each of which is interconnected with field detectors, signaling units and actuators.

1.COMPONENTS REQUIRED :

1. **Sensors/Detectors**: These are the devices which detect smoke, heat or other signs of a potential fire. There are two types – active and passive detectors. Active detectors use motion or sound to detect fires, while passive detectors detect gases and particles in the air.

2. **Control Panel**: This is the brains of the system which receives signals from the sensors/detectors and activates alarms when set limits are exceeded. It also includes indicators for monitoring the connected loop wiring and other integral parts of the system.

3. **Alarm Notification Appliances**: These devices produce distinctive sounds or

visual cues to alert occupants when a fire has been detected. They may be loud horn-like appliances, bells, chimes, flashing lights or strobes depending on its type and purpose

2.CONDITIONS:

Electrochemical. Electrochemical gas detectors work by allowing gases to diffuse through a porous membrane to an electrode where it is either chemically oxidized or reduced.

The amount of current produced is determined by how much of the gas is oxidized at the electrode, indicating the concentration of the gas.

3.WORKING AND PRINCIPLE:

Gas sensors work on the principle of transforming the gas adsorption effects on the surface of the active material into a detectable signal in terms of its changed electrical, optical, thermal, mechanical, magnetic (magnetization and spin), and piezoelectric properties. In magnetic gas sensors, the change in the magnetic properties of the active materials is measured by one of the approaches such as Hall effect, magnetization, spin orientation, ferromagnetic resonance, magneto-optical Kerr effect, and magneto-static wave oscillation effect. The disadvantages of different types of gas sensors include their chemical selectivity and sensitivity to humidity and high temperature operation.

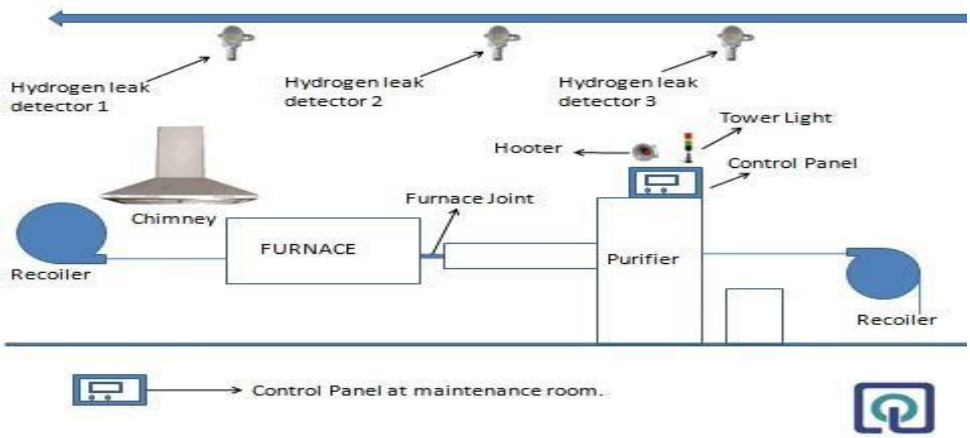
For example, in the case of chemical resistive-type gas sensors, the change in the sensor resistance can drastically vary in the real environment due to the presence of other gas species and the overall electrical effect is quite complex due to simultaneous surface reactions.

Further, it is not easy to make stable contacts for powdered samples for the conventional electrical property-based gas sensors.

4.FUNCTIONAL BLOCK DIAGRAM:

Liquefied Petroleum Gas (LPG) is a main source of fuel, urban areas because it is clean compared to firewood and charcoal.

Gas leakage is a major problem in the industrial sector, residential premises, etc.



Nowadays, home security has become a major issue because of increasing gas leakage Gas leakage is a source of great anxiety with ateliers, residential areas and vehicles like Compressed Natural Gas (CNG), buses, and cars which are run on gas power.

One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection kit at vulnerable places.

5.SOFTWARE IMPLEMENTATION:

Some of the significant factors that need to be considered to install fire and gas (F&G) detection and mitigation system for a chemical processing industry, are discussed. F&G detection system are used to monitor heat, smoke, temperature, and toxic gas .The mitigation system is expected to provide warning and close the operating valves and damper doors, use extinguishers, and stop electrical power supply to prevent the spread of fire and toxic gas.The National Fire Protection Association (NFPA) provide performance-based guidelines to design a fire detection system. A prevention system can reduce the frequency of the hazard, while F&G system reduce the after effects. F&G detection systems can help to achieve operational integrity of any facility by controlling the detection of hazardous gas and smoke.

6.DESIGN AND CALCULATION:

The recent surge in demand for human–machine interaction (HMI), Internet of Things (IoTs), and artificial intelligence (AI) has created both opportunities and challenges for room-temperature wearable gas sensors. These sensors serve as a source of perceptual

information and can be easily integrated into wearable electronic devices due to their portability and miniaturization.In recent years, various types of wearable room temperature gas sensors have been developed for fields like environmental monitoring, healthcare, smart home, industrial security, food safety monitoring, and public security.These sensors not only adjust to the movements of human effortlessly but also have reduced power consumption.Therefore, room temperature wearable gas sensors hold great promise for the development of integrated intelligent gas sensing system worn on the human body. These sensors can be fabricated using various sensing materials to detect diverse target gases.This review provides a comprehensive summary of the preparation of sensing materials with extraordinary sensing capabilities at room temperature

ADVANTAGES:

1. **Early Detection and Alerting** ○ Detects toxic gases (e.g. CO, H_2S, methane) and fire risks early, preventing accidents and saving lives.
2. **Portability** ○ Wearable design allows continuous monitoring regardless of location — perfect for mobile workers
3. **Real-Time Monitoring** ○ Some devices send real-time data to control rooms or mobile apps for immediate action.
4. **Worker Safety in Hazardous Environments** ○ Ideal for industrial workers, firefighters, miners, or chemical plant personnel who work in dangerous conditions.
5. **Compact and Lightweight** ○ Easy to wear without interfering with daily tasks or movement.
6. **Customizable Alerts** ○ Vibration, sound, and visual signals for user-friendly notifications even in noisy environments.
7. **Battery-Powered** ○ Many devices are rechargeable and can run for hours/days, depending on use.

DISADVATAGES:

1. **Limited Detection Range** ○ Can only detect hazards in close proximity to the wearer.
2. **Battery Life Limitations** ○ Regular charging or battery replacement required to maintain functionality.
3. **False Alarms** ○ Environmental factors may cause false positives or negatives.
4. **Cost** ○ High-quality wearable detectors can be expensive, especially for large-scale deployment.
5. **Maintenance Required** ○ Sensors need calibration and maintenance to remain accurate.
6. **Durability Concerns** ○ May be sensitive to water, dust, or physical impacts unless ruggedized.

APPLICATION:

1. **Firefighting**

- Alerts firefighters to toxic smoke or flashover risk in real-time.

2. **Industrial Workplaces**

- Factories, refineries, and chemical plants where hazardous gases may be present.

3. **Mining**

- Detects methane or carbon monoxide to prevent explosions and poisoning.

4.Construction Sites

- Detects combustible materials or gas leaks during building activities

CONCLUTION

The development and deployment of wearable fire and toxic gas detectors mark a significant advancement in personal safety technology, especially for workers in high-risk environments such as manufacturing plants, chemical industries, mining sites, and firefighting operations. These compact, lightweight devices are designed to continuously monitor the surrounding atmosphere for the presence of hazardous gases such as carbon monoxide, methane, hydrogen sulfide, and other flammable or toxic substances. In addition, they are capable of detecting sudden temperature rises or the presence of fire, enabling early alerts that can prevent injuries, fatalities, and property damage. By offering real-time alerts, integrated GPS tracking, and wireless connectivity, these wearable detectors not only ensure prompt evacuation and emergency response but also support efficient incident tracking and safety management. The integration of such wearable technologies into standard safety gear represents a proactive approach to hazard prevention, emphasizing the importance of personal safety in occupational settings. As technology continues to evolve, the adoption of wearable fire and toxic gas detectors will become increasingly vital in building a safer, more responsive work environment, ultimately saving lives and improving workplace health and safety standards. The introduction of wearable fire and toxic gas detectors represents a transformative step in enhancing occupational safety and health standards, particularly in high-risk environments such as oil and gas refineries, chemical plants, mining operations, construction sites, and firefighting missions. These advanced devices offer real-time monitoring of harmful gases like carbon monoxide (CO), hydrogen sulfide (H_2S), methane (CH_4), and other volatile organic compounds (VOCs), which are often undetectable by human senses until it's too late

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