SMART LIGHTNING ARRESTER FOR THE FIREWORK INDUSTRY USING IOT

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ABSTRACT

This paper aims to provide a cost-effective lightning protection system for the explosive fireworks industry, integrating real-time monitoring and automatic measures. The system includes lightning arresters, surge protection devices, grounding systems to safely direct lightning into the ground by measuring how well it functions, and sensors to monitor lightning strikes. IoT connectivity via an ESP32 microcontroller allows real-time data transmission and remote monitoring. Fire detection sensors, such as smoke, flame, and heat sensors, are included to detect and respond to fire accidents. The system ensures compliance with industry regulations and provides safety management through a user interface and satisfies sustainable development goal 9, industry innovation and infrastructure.

Keywords: Cloud monitoring, Fire detection sensors, Grounding System, IoT, Lightning arrester.

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1. INTRODUCTION

In the fireworks industry, lightning strikes can be a significant danger due to the presence of flammable materials, so having a good lightning protection system is very important. This paper creates a system that's affordable and easy to set up. The system will include tools like lightning arresters to catch lightning and grounding systems to safely send electrical energy into the ground to protect electrical equipment. Real-time monitoring will help to keep an eye on things. And make maintenance easier. Rods will be placed in key spots to catch lightning strikes, and wires will guide the electricity to the ground safely. Monitoring will ensure the system works well, reducing the chance of accidents caused by lightning. Lightning strikes can cause very high voltage spikes (transients) in a short time, potentially damaging electrical equipment, including transformers. Transformers are one of the important components in the distribution of electrical energy, which serve to increase or decrease voltage as needed. For transformer operation to remain reliable and safe, adequate protection against various disturbances is needed, one of which is interference due to lightning strikes. Lightning arresters function to protect the transformer by diverting excess energy from a voltage surge directly to the ground, thus preventing damage to the transformer. Lightning surge arresters are a key component for the protection andreliability of the power system. Lightning surge arresters play a crucial role in protecting electrical power systems from transient over voltages caused by lightning strikes.

2. PROPOSEDSYSTEM

Lightning Rods and Grounding Systems are safeguard structures by safely direct lightning strikes into the ground, preventing damage and ensuring safety. Sensors are used to detect environmental changes such as gas leaks, weather variations, current irregularities, and lightning activities. Data processing unit (Arduino UNO/Node MCU), which gathers and processes data from sensors to assess actions required for safety. Wireless communication (GSM), it sends data or alerts via notifications to the specified IP address, ensuring real-time communication of hazards. Data analytics (Things speak) is a cloud-based IoT platform for collecting, visualizing, and analyzing real-time sensor data to predict risks and optimize safety measures. NoSQL database (MongoDB) is used to store and manage large volumes of real-time, unstructured IoT data, providing scalable and efficient data decisions. LCD Display shows real-time data, aiding safety decisions.

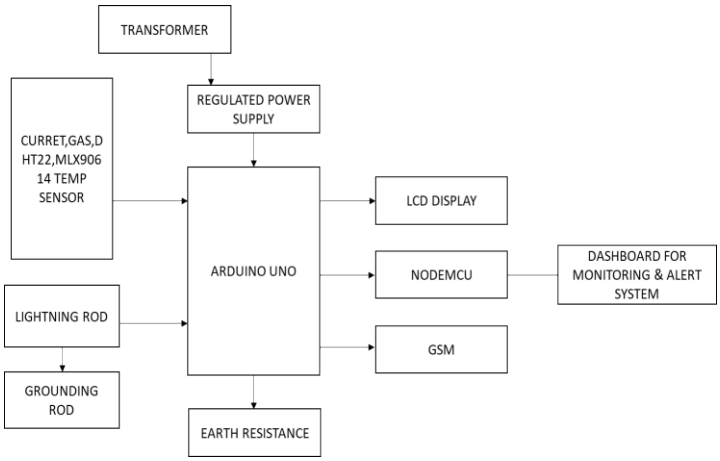

Fig 2.BlockDiagram

3. HARDWAREDESCRIPTION

1) **Transformer:** Converts the high-voltage AC Power supply into a lower voltage suitable for the circuit.

2) **Regulated power supply:** Ensures a stable DC voltage for powering the Arduino Uno and connected components, maintaining consistent performance.

3) **Arduino Uno:** Acts as the central processing unit, collecting data from all the sensors, processing it, and controlling outputs.

4) **Current sensor:** Monitor the flow of current in the circuit to detect any abnormal changes that might indicate potential issues.

5) **Gas Sensor:** Detects harmful or combustible gases in the Environment, ensuring safety by identifying possible gas leaks.

6) **DHT22 Sensor:** Measures ambient temperature and humidity with high precision, useful for maintaining optimal environmental conditions.

7) **MLX90614 Infrared Temperature sensor:** Provides non-contact temperature measurement, ideal for detecting heat sources or monitoring temperature-sensitive setups.

8) **Earth Resistance Meter:** Ensures Proper grounding by measuring the resistance of the earth connection , critical for safety in Electrical systems.

9) **LCD Display:** Displays real-time data from the sensors and alerts to provide Users with on-the-spot information.

10) **NodeMCU (Wi-fi Module):** Facilities Wireless communication by transmitting data to a remote server or dashboard for monitoring purposes.

11) **GSM Module:** Sends alerts via text message or calls, providing a backup communication method in case Wi-Fi is unavailable.

12) **Dashboard for monitoring & Alerts:** A User-friendly interface that allows users to view real-time data, analyse trends, and receive alerts about critical conditions.

13) **Lightning Rod:** A Metallic rod placed at the highest point of the firework facility to safely attract lightning strikes. It is connected through conductors to the ground, Providing a direct, low-resistance path for Lightning Current to flow harmlessly into the Earth.

14) **Grounding System:** A Strong earthing setup connected to the lightning rod, designed to safely dissipate the high voltage energy into the ground, minimizing risks to the facility.

15) **Data Analytics(Thingspeak):** A cloud-based IOT Platform for collecting, visualizing, and analysing real-time sensor data to predict risks and optimize safety measures

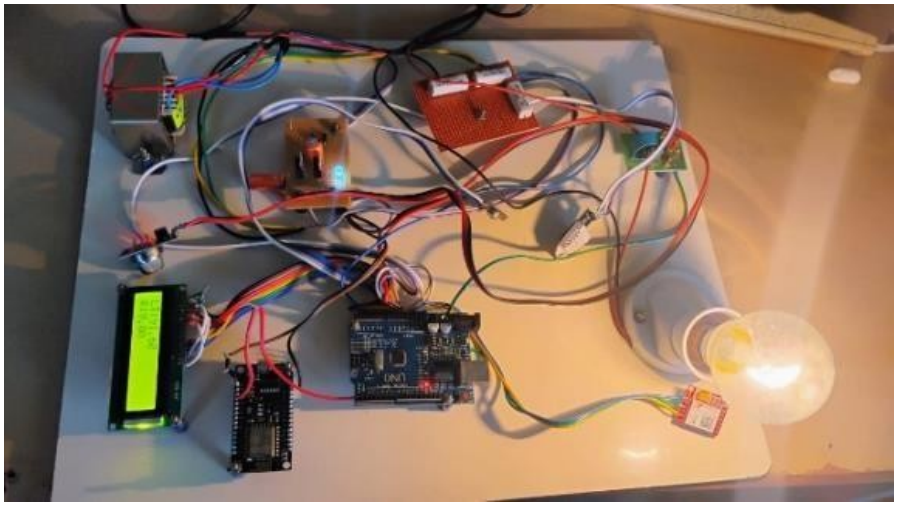

Fig 3.Hardware implementation

4. RESULTS AND DISCUSSION

The implementation of a lightning protection system for the fireworks industry has significantly boosted safety and reduced risks associated with lightning strikes. The system includes lightning arresters, surge protection devices, and grounding systems that safely reduce risks. Smart sensors are added to track important things like lightning strikes, power surges, and ground safety. They will update live accidents and make sure the system works well. This system is strong and reliable, which mixes traditional methods and modern technology. The data is collected and stored using IoT. This system is developed with certain standards, which manage the risks in the fireworks industry. This system will reduce lightning-related accidents and make the workplace safer for both workers and buildings. This system protects the workers and also safeguards the materials used in the industries. This method is a combination of traditional methods and modern technologies for ensuring safety. It creates as afer environment for both workers and infrastructure by integrating advanced technologies like smart sensors and IoT. Overall, it is a reliable solution for ensuring safety in the fireworks industry.

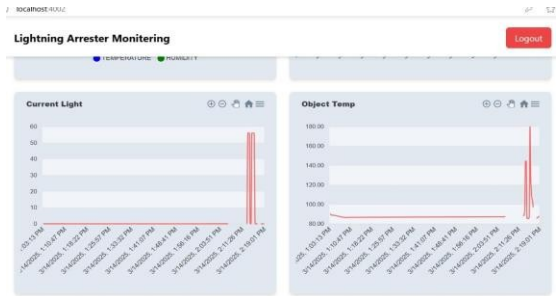

Fig 4.1Graphical representation of Current Light & Object Temperature

Fig 4.2 Result Analysis of Temperature & Gas

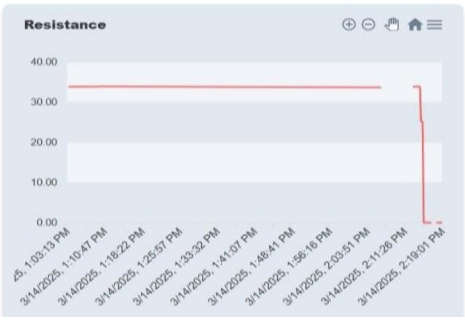

Fig 4.3 Resistance is measured and displayed.

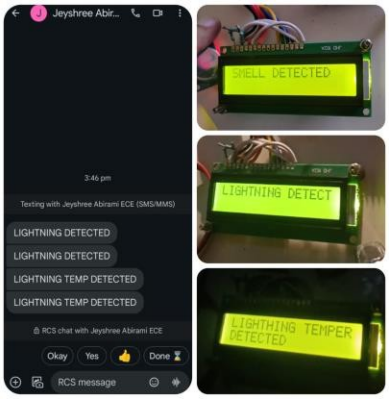

Fig 4.4 Lightning Monitoring and Obstacles Detection

5. CONCLUSION

The system is mainly developed for the fireworks industry to improve safety and reduce risks. The tools, like lightning rods, grounding systems, and various sensors, are used to protect the industries from lightning-related dangers.

This project combines advanced sensor technology and IoTconnectivity, thus making the system reliable and cost-effective. It creates a safer working environment for both workers and the infrastructure of the fireworks industry.

In summary, the smart lightning arrestor prototype integrates IoT to collect data from sensors. Wireless connectivity enables emergency data transmission and real-time monitoring. An LCD interface enhances safety measures. It stores the previous data in the dashboard to make predictions easily.

6. ACKNOWLEDGMENT

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