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IOT Based Illegal Coal MiningDetection System

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Abstract: ***When it comes to mining, there are two extremely crucial issues to consider: safety and legality. Illegal mining has been reported in numerous places of India. Combating this problem and ensuring that mining activity is carried out safely, as well as enhancing the effectiveness of discovering unlawful mining activities, is a serious task. At the moment, there is no effective way of detecting the presence of uncertainty in mines at an early stage, and as a result, people are dying. Natural disasters such as earthquakes, automobile collisions, and mine wall failures are all major risks. This project aids in the detection of unlawful mining in safe zones, hence preventing natural disasters. It also uses sensors to send values to the appropriate authorities when it detects any abnormal behavior .When the nodes thatforward the data are picked dynamically based on their battery life, energy efficiencyis practiced. The tool will also keep track of mining activities in remote areas.***
Keywords: Illegal Mining, Node MCU, sensors, MQTT.

I. INTRODUCTION

The world's most hazardous location to work is a mine since explosions there frequently result in thousands of fatalities. And according to a recent report, these mine mishaps have resulted in an average death toll of about 12,000 people. There are several coal mine accidents that occur in the mines, and the miners are putting their lives in danger by working there. Unfortunately, it happens occasionally that miners lose their lives in the coal mines, making them an unsustainable source that cannot be widely replaced by humans.

Such catastrophes frequently occur as a direct result of outdated machinery and electrical devices, leading to improper handling, the spilling of toxic gases in coal mines, pose significant risks to excavators inside coal mines. To avoid this issue, we have devised the coalmine prevention system. By putting to the test the data gathered by the sensors, using it, and concluding the analysis, we addressed the problems in our research. Controlling is possible either automatically or by hand.

The extraction of coal has a negative impact on the ecosystem as a whole. The restless human race continuously uses a variety of resources for daily living on the unstable globe.

It is well-known that coal has been India's primary energy source for many years and that it accounts for close to 27% of the world's commercial energy needs. Surface or opencast mining and underground mining are the two primary technologies used to mine coal. The type of mining is determined by the geological conditions.

Natural resource deterioration and habitat devastation are frequently linked to coal mining. As a result, the area becomes home to exotic species, endangering biodiversity. Numerous mining operations in the coal mining region generate enormous amounts of garbage.

Mining will harm the ecosystem if suitable precautions are not taken for waste management. The way trash is disposed of has an impact on the surrounding areas' air, water, and land, which in turn has an impact on local residents' quality of life.

Whether it's large-scale industrial mining or tiny artisanal mining, mining is still a hazardous industry. In addition to accidents, exposure to dust and pollutants, stress from the work environment, and managerial demands all contribute to a variety of ailments that miners are susceptible to. I examine mining and health from a number of vantage points, including those of the common man (much of life depends on mined components in the house ,car and phones) a public health physician (mining health is influenced by a variety of factors, often acting in combination, ranging from individual inheritance—genetic make-up, sex, age; personal choices—diet, lifestyle; living conditions—employment, war; social support—family, local community; environmental conditions—education, work; to nation); as a member of the Society for Environmental Geochemistry and Health (environmental contamination and degradation leads to ill health in nearby communities); as a volunteer (mining health expenditures are not just borne by the mining industry or the miners themselves, but by all of us who receive mining benefits); and as a lay preacher (the current global economy concentrates on profit at the expense of the health of miners). Collaboration between academics, communities, governments, and businesses should result in the development of evidence-based solutions. It is not necessary for employment, health, economic stability, and environmental conservation to be incompatible. We must all take action.

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II. LITERATURE REVIEW

1) Rajkumar Boddu et al., [1] created a mechanism for monitoring the safety of coal mines, The old wired network systems used for coal mine monitoring are being replaced by a safe coal mine monitoring system in this work. This has a significant impact on coal mine safety production. Many lanes in coal mines become monitoring blind regions with lots of hidden threats as exploitation areas and depth continue to grow. Furthermore, laying wires, which is costly and takes time, is inconvenient. In order to address the issues, we created a wireless sensor network-based coal mine safety monitoring system that can increase the level of production safety monitoring and decrease accident rates. For experts who are committed to resolving the issues with coal mine safety monitoring, Zigbee technology offers a direction. This study's goal is to offer an appropriate solution for wireless communication in the mining industry, monitor safety, and provide evidence for additional research.
2) Wakode et al., [2] developed a method that was primarily used to track the level of hazardous gases in coal mines. The alerts that the devices provide for safety will enhance the mine miners' chances of survival. The transceiver and receiver sides each have an emergency alert switch. The safety of miners is a significant problem today. The health and well-being of miners are at risk from a number of serious problems, including the working environment and its consequences. A new strategy is needed to boost productivity, lower costs, and take worker safety into account in the mining industry. Based on wireless sensor network can timely and accurately reflect dynamic situation of staffin the underground regions to ground computer system and mobile unit.
3) Cheng et al., [3] proposed a system for monitoring coal mine safety that is based on A ZigBee wireless sensor network and GPRS wireless remote transmission were used to create a wireless coal mine safety monitoring system that benefits from real-time parameter monitoring and rapid networking. The associated director can be alerted through brief message sent to his cell phone thanks to the development of remote data transmission using GPRS, which helps to identify significant incidents early and provide real-time care, improving coal mining safety.
4) Dheeraj et al., [4] In order to preserve the safety of coal mine workers, a framework was proposed in which the values of all monitored parameters would be saved, visualised, and controllable through smartphone in the cloud. The world around us is being revolutionised by the rise of digital transformation. Digitalization will be fundamental to the mining sector as well, where connectivity is crucial. In order to enable things to communicate and exchange data with one another, presumably but not necessarily via the Internet, it is intended to embed electronics, sensors, and software into an increasing number of objects.
5) Lihui et al., [5] This study develops a Zigbee wireless sensor network-based monitoring system for coal mine safety. Through Zigbee sensor nodes placed throughout the mine, the monitoring system gathers temperature, humidity, and methane values underground in coal mines, and then transfers the information to an ARM-based information processing terminal. Through Ethernet, the terminal transmits the data to the ground, where the monitoring centre examines it before publishing it to the LAN for remote users to access. If the data exceeds the set limit, the system can SMS related safety employees. This system has made it possible to monitor the working surface in real time.
6) Dong et al [6] A framework for coal mine safety monitoring that relies on GPRS and Zigbee remote transmission has been presented. With the invention of GPRS, remote information transmission was made possible and informed via short messages sent to his cell phone, which adds to the early ID of genuine mishaps and continuoustreatment, subsequently expanding the security of coal mining.
7) Aarti et al [7] a system that continuously updates a webpage with temperature, humidity, and methane data from a coal mine is being built. All of the values are delivered to an ARM9 CPU via a Wi-Fi module.
8) Ashish et al., [8] detailed a system that uses a temperature sensor, a humidity sensor, and a gas sensor, among other sensors, to operate. To monitor the conditions, an IR sensor is positioned inside the mine. The major goal was to present a workable design scenario for wireless sensor networks in underground coal mines (WSNs). The fundamental justification for this is because only low power WSN nodes can offer precise surveillance and accident detection data due to the complexity of a coal mine's physical structure. Designing and modelling many alternative scenarios for a typical mine was the main focus of the study, and from there, comparing the findings to come up with a final design. When it comes to embedded technology, More and more applications are using the Zigbee protocols. Our autonomous real-time monitoring of coal mines is now possible because to the quick development of sensors, microcontrollers, and network technology. The subterranean system measures the temperature, humidity, and methane levels inside the coal mine using sensor nodes; it also counts the number of people inside the mine using an IR sensor, and it communicates the information to an ARM-based information processing terminal.
9) Dange et al., [9] [A suggested design based on the MSP430, There are difficult situations in the coal mine today as a result of climate change and global warming.

Atomization in the coal mining industry is in fact required to lower costs, increase production, and improve product quality. This will also lessen the workload for mine personnel. In this study, a design for a wireless sensor network (WSN) using an MSP430xx controller is proposed. This WSN will be able to track the temperature, humidity, gas levels, and smoke status in an underground mine. This system also regulates the need for ventilation for mine employees based on the climate inside the mine at the time field. This system makes use of the low-power, reasonably priced MSP430 microcontroller, a temperature sensor LM35, a humidity sensor SYSH220, a smoke detector, and a gas sensor to sense the mine's climate parameters, as well as a wireless Zigbee transceiver for remote data logging at a central location. The motor and valve control circuitry then uses this information to control the climate state.

10) Madhu et al [10] created a mechanism for monitoring coal mine safety using Checks are made on the air's temperature, humidity, and carbon dioxide content. When an uncertain situation arises, a message is sent to the fire and forest agencies using GSM.

11) Fischer (2007) To build a fire detection system, the simulation technique was taken into consideration and used. To reduce the probability of false alarms during non-fire events, this system both detects and distinguishes between fire and non-fire spots.

12) Tan et al. (2007) designed a system, which is applied for mine safety monitoring. They called the system WSN based Mine Safety System. This system is capable ofreal time monitoring of the mine environment and provide the pre-warning for the fire or explosion.

13) Niu Xiaoguang et al. (2007) introduced the prototype of a distributed heterogeneous hierarchal mine safety monitoring system (HHMSM), which is based on characteristics of the underground mine gallery and requirements for mine safety. This device keeps track of the miner's location and methane content. They suggested a hearing-based adaptive data collection system that uses the sampling readings' redundancy and correlation in both time and location to facilitate traffic and control.

14) Hongjiang et al. (2008) designed a system using low power ARM (Advanced RISC Machines) processor chip S3C2410 as the control of core and Zigbee as a communication platform of WSN. This system composed of network mode, communication network of CAN BUS as well as monitoring sensors. Zheng Sun et al. (2008) evaluated the issues with an enhanced TinyOS Beaconing-based WSN and mine safety monitoring. This protocol has the ability to automatically detect energy needs and repair routes, as well as to limit the growth of child nodes and system levels. Small routing Table, high stabilisation, high self-repairing, and long lifetime are the features. It could be used to monitor mine safety and acquire data for coal mines.

15) Lin-Song Weng et al. (2009) planned a framework that is effectively monitoring all mining conditions, especially for the wellbeing of mineworkers. The real-time mine auxiliary monitoring system (RMAMS), which is accepted for a real-time mine-monitoring system, is the term given to the system. The Mine Auxiliary Sensor System (MASS) makes a decision to end the processing process using an intelligent activity sensor and repeater.

16) Hua Fu et al. (2009) Using their research on fuzzy theory and neural network technology, they created an intelligent fuzzy neural network sensor system for coal mines. This technology is capable of making precise parameter detections.

III. METHODOLOGY

We provide a technique for identifying illegal mining in safe areas that aren't authorised for mining, safeguarding and averting natural hazards. The main objective of the system is to employ sensors, Node MCU, and MQTT Broker to alert the proper authorities in real-time about illegal mining. The appropriate official receives a push message alerting them to the events taking place in that area. Administrators are able to monitor operations from any location in the world as a result.

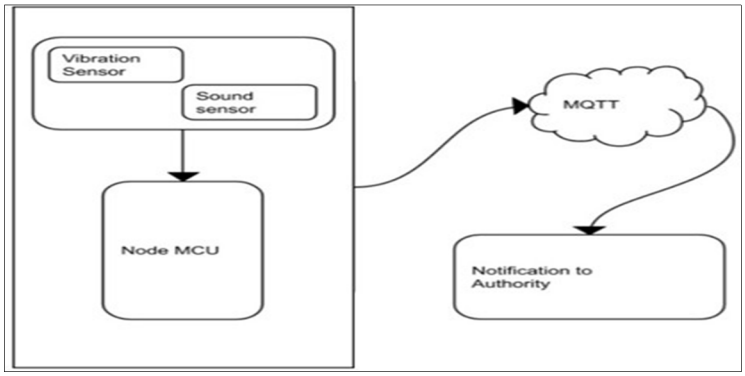
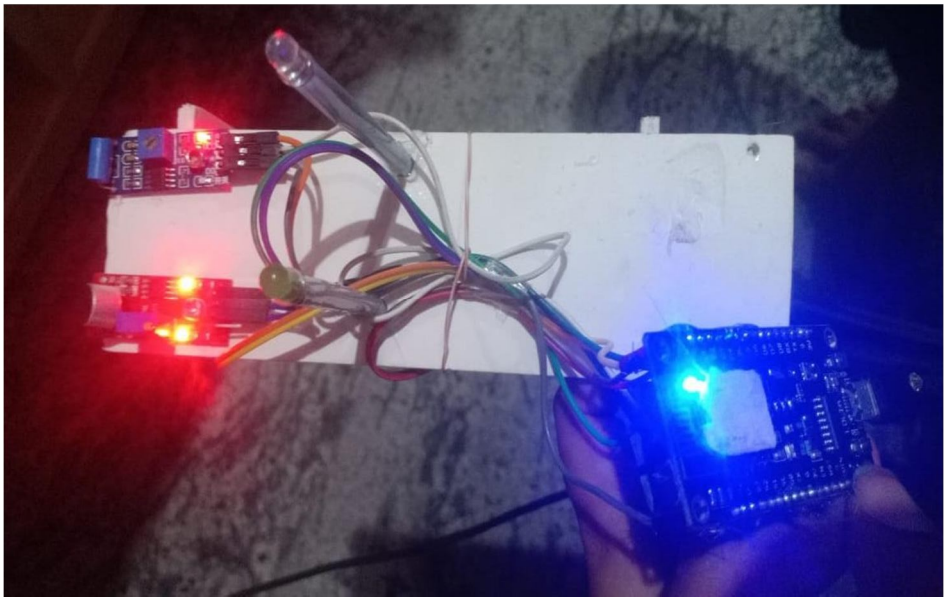


Fig 1: steps carried out in coal mining detection

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A. Hardware Part

Placed in areas where coal mining operations can be conducted are the Sound and Vibration sensors. As they sense their environment, the sensors communicate values to the NodeMCU microcontroller. The LED lights flicker as soon as the value is delivered from the sensors to the micro-controller thanks to their placement between the NodeMCU and the sensors. The microcontroller is programmed to compile the sensor data and send it over the Hivemqtt network protocol to the Hive Cloud.



B. MQTT Server

The broker, which is the NodeMCU, and the client, which is the Desktop application, are both signed by the same topic using the Hivemqtt software when the NodeMCU transmits sensor data to the cloud.

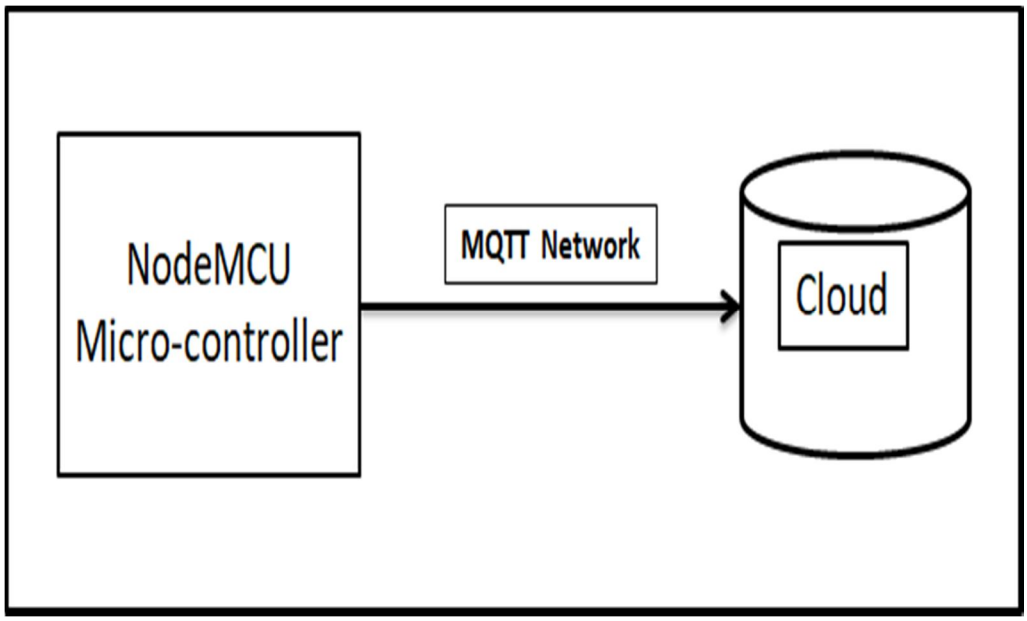
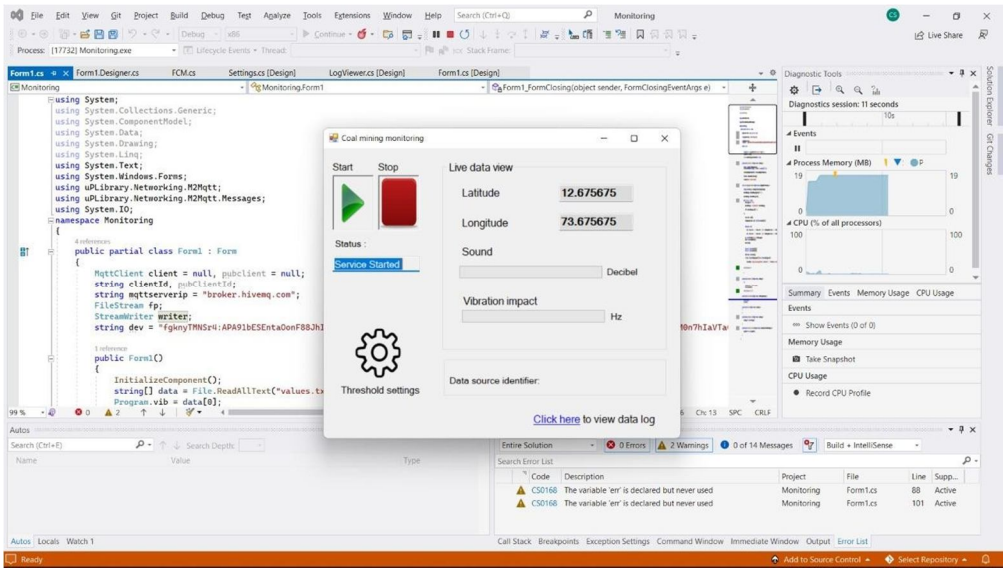


Fig 3: MQTT Protocol Network

C. Desktop Application

The data gathered from the hive cloud will be compared against the desktop application's threshold settings. The desktop application will note the latitude and longitude of the location where the sensors are positioned and send it to the higher authorities for further action if the collected values exceed the threshold values.

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Android Application

For the notice, the apk file is downloaded to the government official's phone. To determine if the mining operation is legal or illegal, the desktop application will alert the cops. Once the message has been clicked, a link to Google Maps will open, displaying the precise location of the mining activity so that the next course of action can be demonstrated.

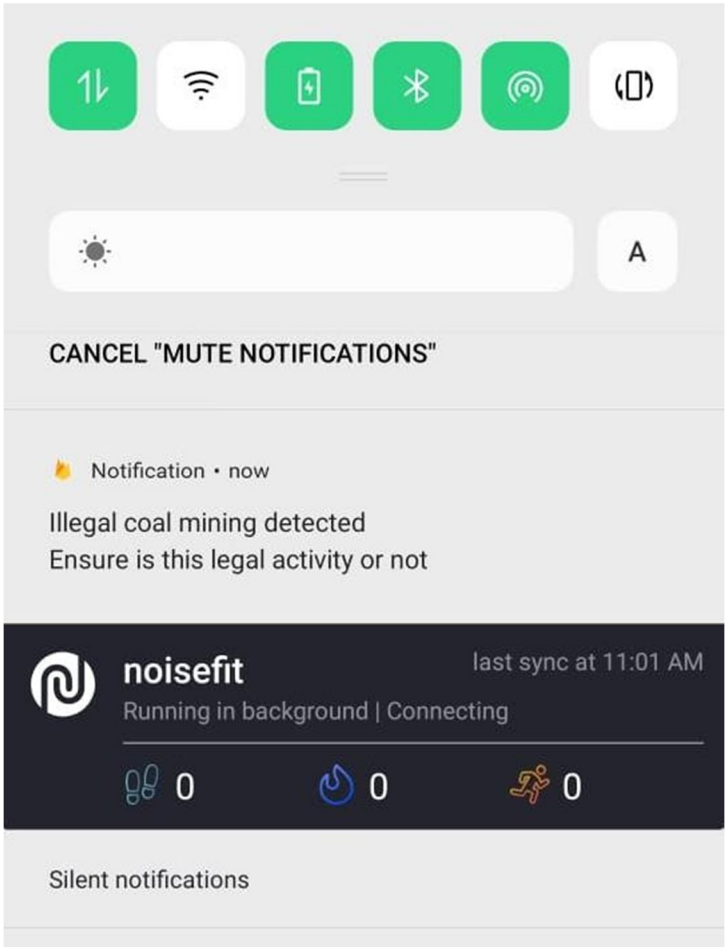


Fig 4: Android Notification

IV. CONCLUSION

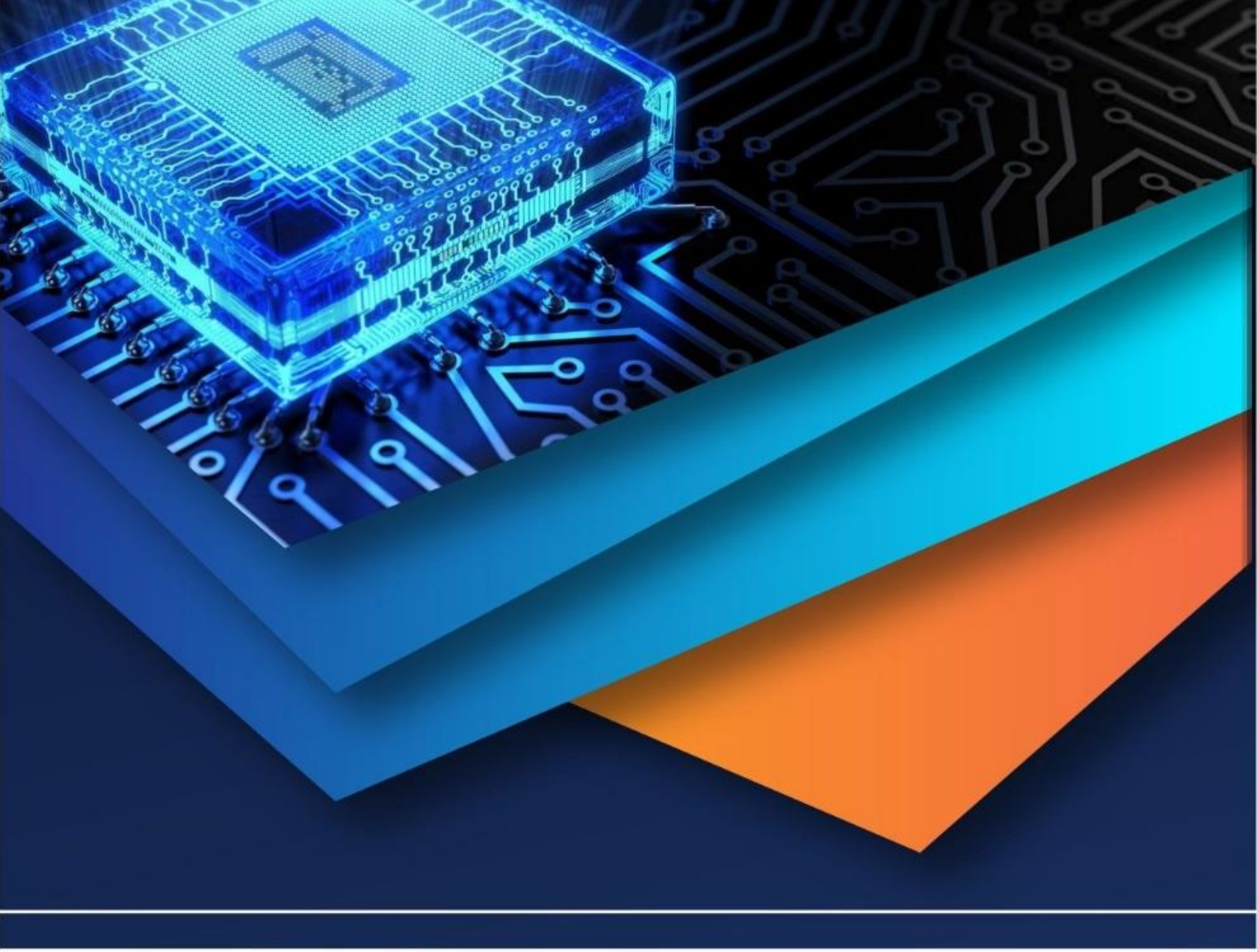
The project's goal is to find illegal mining operations in off-limits locations. The system operates in real-time thanks to sensors. Both sound and vibration sensors are employed. Registered aggregate nodes deliver the values to the base station. These nodes are dynamically chosen according to their battery level. The node that transmits the parameters to the base station is the one with a higher battery %. The readings collected on site are contrasted with the threshold values entered into the base station's system. When the threshold value is exceeded, the device of the relevant authority receives a push notice. This enables them to act quickly and keeps the safe zone region free from unauthorized mining operations.

The idea of "IOT" challenges conventional wisdom, introduces new ideas, technologies, and management techniques for managing and supervising safety, aligns with the idea of scientific and security development, and captures the essence of the maxim "Safety and prevention first, comprehensive treatment." Adopting IOT technology for remote dynamic supervision will allow for the innovation of coal mine supervision patterns, the achievement of tracking inspection on illegal activity, the expansion of emergency response and accident investigation capabilities, the further improvement of the situation of safe production, and the promotion of the safe and stable growth of the coal industry.

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