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IoT based Illegal Coal Mining Detection

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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 that forward the data are picked dynamically based on their battery life, energy efficiency is practiced. The tool will also keep track of mining activities in remote areas.*
Keywords: *Illegal Mining, Node MCU, sensors, MQTT.*

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I. Introduction

The Internet of Things (IOT) and related technologies are rapidly gaining popularity in which connectivity is established between "things" in order to enable data sharing in any monitoring environment without the need for human intervention. Physical equipment, transportation vehicles, and any other items that are embedded with the electronic supply are examples of "things." As a result, remote monitoring via IOT technology is rapidly expanding .The Internet of Things (IOT) is how we design the digitally connected world of daily physical items. These devices will have internet connectivity, sensors, and other communication technology. IOT makes "not so smart" things "smarter" by allowing them to transfer data over the internet and communicate with people and other IOT-enabled objects. A familiar example of IOT is the connected "smart television". Thermostatic devices, doorbells, smoke detectors, and security devices that are connected to the internet create a connected area where data is shared between physical devices and users can control these devices in that hub from afar (example: adjusting temperature, unlocking doors, etc.) via a mobile app, a web application, or a website. The Internet of Things is far from being limited to the house; it can be found in a variety of devices, including industrial machines. IoT is making the world wiser by connecting the real and digital worlds, from smart boards in school classrooms to medical gadgets that can detect signals of various diseases. Mines are one place where monitoring might be beneficial. Mining dangers can occur, resulting in a high number of accidents and losses. A tremulous hazard, which is widespread in underground mines, is one such example of a unique type of danger. It's comparable to an earthquake in that it's difficult to detect and forecast. It's tough to maintain a constant eye on mines because they're so far away from human settlements. In this project, a solution to the problem will be shown. For environmental reasons, the IOT Model should be installed in locations where mining is prohibited. Using the suggested method, such illicit mining activities can be detected. The following is the itemization of how this paper is organized. Section 2 is the Problem Statement; Section 3 is an overview of the Proposed System; and Section 4 is the conclusion. Section 4 provides an overview of the proposed system's System Architecture, while Section 5 discusses the Data Flow Diagram. The testing of the system and the results collected are discussed in Section 6. The conclusion is found in Section 7. The References section is in Section 8.

II. Literature Review

RajkumarBoddu et al., [1] developed a coal mine safety monitoring system, In this work, a safe Coal Mine Monitoring system which replaces the traditional coal mine monitoring systems which tend to be wired network systems. This play an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become monitoring blind areas, where are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we designed a coal mine safety monitoring system based on wireless sensor network, which can improve the level of monitoring production safety and reduce accident in the coal mine. Zigbee technology provides a direction for scientists who commit to solve the safety monitoring problems of

coal mine. The purpose of this study is to propose a solution suitable to mine wireless communication, safety monitoring, give a proof to the further study.

Wakode et al., [2] suggested a system that mainly used to monitor the concentration of dangerous gases in the coal mine. To provide safety the systems gives the alerts that will be helpful to the workers in the mine to save their lives. An alert switch is placed at the transceivers and receiversside for emergency purpose. Today, safety of miners is a major challenge. Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. To increase the productivity and reduce the cost of mining along with consideration of the safety of workers, an innovative approach is required. Coal mine safety monitoring system based on wireless sensor network can timely and accurately reflect dynamic situation of staff in the underground regions to ground computer system and mobile unit.

Cheng etal., [3] Proposed a coal Mine safety Monitoring framework dependent on A wireless coal mine safety monitoring system based on ZigBee wireless sensor network and GPRS wireless remote transmission was established, which enjoys the characteristics of ZigBee technology, including quick networking and real-time parameter monitoring. With mature GPRS technology, remote data transmission was achieved and associated director can be informed through short message sent to his cell phone, which contributes to the early identification of serious accidents and real-time treatment, thus increasing the safety of coal mining.

Dheerajetal., [4] suggested a framework that values of all the parameters that are monitored are stored and visualized in the cloud and those can be controlled using smart phone so that safety of the coal mine workers are maintained. Digital transformation is emerging as a driving force to revolutionize the world around us. Digitalization will play defining role in the mining industry too where connectivity plays a gigantic role. The idea is to embed more and more things with electronics, sensors, and software to allow things to communicate and exchange data with each other possibly but not necessarily via the Internet.

Lihuietal., [5] This paper designs a monitoring system for coal mine safety based on Zigbee wireless sensor network. The monitoring system collects temperature, humidity and methane values underground of coal mine through Zigbee sensor nodes around the mine, and then transmits the data to information processing terminal based on ARM. The terminal sends the data to the ground through Ethernet, and then the monitoring centre monitors the data and publishes them to the LAN for remote users to inquire. If the data is ultra-limit, the system can send SMS to related personnel of safety. This system has realized the real-time monitoring of working surface.

Dong et al [6]proposed a coal Mine safety Monitoring framework dependent on Zigbee and GPRS remote transmission was established. With GPRS innovation, remote information transmission was accomplished and informed through the short message sent to his cell phone, which adds to the early ID of genuine mishaps and continuous treatment, subsequently expanding the security of coal mining.

Aarti et al[7] developed a system that monitors temperature, humidity, methane values in the coal mine and all the values are sent to the ARM9 processor and a using a Wi-Fi module the values are continuously updated in the webpage

Ashish et al., [8] described a system that is based on ARM controller and different sensors like temperature sensor, humidity sensor and the gas sensor. An IR sensor is placed in the mine to check the conditions. The main purpose was to provide an implementable design scenario for underground coal mines using wireless sensor networks (WSNs). The main reason being that given the intricacies in the physical structure of a coal mine, only low power WSN nodes can produce accurate surveillance and accident detection data. The work mainly concentrated on designing and simulating various alternate scenarios for a typical mine and comparing them based on the obtained results to arrive at a final design. In the Era of embedded technology, the Zigbee protocols are used in more and more applications. Because of the rapid development of sensors, microcontrollers, and network technology, a reliable technological condition has been provided for our automatic real-time monitoring of coal mine. The underground system collects temperature, humidity and methane values of coal mine through sensor nodes in the mine; it also collects the number of personnel inside the mine with the help of an IR sensor, and then transmits the data to information processing terminal based on ARM.

Dange et al., [9] proposed design which is built on MSP430, Now a day's due to global warming and climate changes there are challenging situations in field of coal mine. To reduce the cost and improve the productivity along with product quality the atomization in the field of coal mine is indeed necessary, which will also reduce the mine workers efforts. This paper proposes a design of a wireless sensor network (WSN) with the help of MSP430xx controller which is able to monitor the temperature, humidity, gas and status of smoke in an underground mine. This system also controls the ventilation demand to mine workers depending upon present climate conditions within the mine field. This system utilizes low power, cost effective microcontroller MSP430, a temperature sensor LM35, humidity sensor SYSH220, smoke detector, gas sensor for sensing the mine climate parameters and a wireless Zigbee transceiver for remote logging of data at central location to control the climate state with the help of motor and valve control circuitry.

Madhu et al [10] developed a coal mine safety monitoring system by utilizing Temperature, humidity and the amount of carbon-dioxide present are checked. If any uncertain condition occur then message is sent with the help of GSM to the forest and fire departments

III. Proposed System

We propose a method for detecting unlawful mining in safe zones that are not licensed for mining purposes, thereby protecting and preventing natural dangers. The system's main goal is to use sensors, Node MCU, and MQTT Broker to report real-time unlawful mining to the appropriate authorities. It sends a push message to the pertinent official informing them of the activities in that region. As a result, administrators can keep an eye on things from anywhere in the world. The number of nodes deployed in our model is two, and the remainder may be handled by an android application that works as a sensor replica.

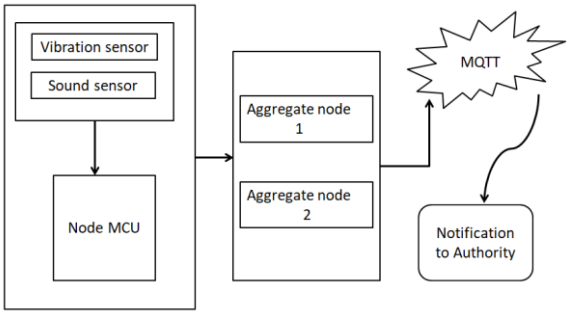

Figure 1

Figure 1 displays the entire functioning model of the proposed system. The sensors send the magnitude of sound and vibration to the aggregate node via the Wi-Fi module. The aggregate node with the highest percentage of batteries is chosen. This is a dynamic process that ensures energy efficiency as well. The parameters (latitude, longitude, sound amplitude, vibration amplitude) are then sent to the base station using MQTT Broker. If the collected results exceed the system's threshold values, an alert message is sent to the appropriate authority.

IV. Conclusion

Our project aims at detecting *illegal mining* activities in restricted areas. With the use of *sensors*, the system works in real-time. The sensors used are sound *sensors* and vibration *sensors*. The values are transmitted to the base station via registered aggregate nodes. These nodes are selected dynamically based on their battery percentage. The device with a higher battery percentage is the node that passes on the parameters to the base station. The values obtained on site are compared with the threshold values inputted in the system in the base station. When the threshold value is exceeded, a push notification is triggered to the concerned authority's device. This helps them to take up immediate action and thus, helps to keep the safe zone area protected from *illegal mining* activities.

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