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IOT BASED MINING TRACKING AND WORKER SAFETY HELMET

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ABSTRACT :-

Coal mines are one of the most important industries in the country, as they are used as fuel in the steel and cement industries to extract iron from the stone and create cement. The coal mining industry is known for its hazardous working environment, requiring stringent safety measures to protect miners and prevent accidents. The coal mine safety and monitoring project provides a comprehensive solution to enhance safety within coal mines. The objective of this project is to continuously monitor critical parameters such as temperature, gas concentration, and water level to ensure a safe working environment in coal mines. The continuous monitoring of temperature, gas concentration, and water level, along with remote communication capabilities and alerting mechanisms, contribute to minimizing the risk of accidents, improving response times, and overall safety standards within coal mining operation. Mining is one of the most hazardous industries, with risks such as cave-ins, gas leaks, and equipment malfunctions threatening worker safety. This project presents an IoT-based Mining Tracking and Worker Safety Helmet designed to enhance safety and real-time monitoring in underground mines. The system integrates various sensors (such as gas, temperature, and motion sensors) with GPS and RFID technology to track miners' locations and detect dangerous environmental conditions.A microcontroller unit processes the sensor data and transmits it to a central monitoring system via Wi-Fi or LoRa for real-time analysis. In case of emergencies like toxic gas detection, high temperatures, or worker immobility, the system triggers immediate alerts through buzzer alarms, LED indicators, and wireless notifications to supervisors. Additionally, a panic button allows miners to send distress signals.This smart helmet significantly improves worker safety, efficiency, and emergency response by ensuring continuous monitoring and instant hazard detection. It represents a crucial step toward integrating IoT into the mining industry, reducing accidents, and saving lives.

Keywords:- flexible , Temp sensor , IOT system, Smart helmet, Reliable

1 INTRODUCTION :-

Mines are the world’s most dangerous place to work because in the mines, explosion often happens and thousand people are dying. And a recent report state that in such mine accidents an average of around 12,000 people have died. Coal is a no sustainable origin that cannot be widely replaced by humans, there are several mishaps of coalmines occurring in the mines, and the diggers are putting their lives at-risk, by working in the coal mines, even once in a while they end up losing their lives in the coal mines that are an unfortunate part. Mainly such mishaps happen as a direct result of the old equipment and wired devices, resulting in the end, mishandling, spillage of the noxious gases in the coal mines, pose tremendous hazards to the excavators inside the coal mines. So we’ve designed the coalmine protection system to stay away from this problem. We tackled the issues in our research by testing each of the information collected by the sensors, we use and finishing the analysis using the Thinker system. Controlling can be done automatically or manually.This smart helmet integrates Internet of Things (IoT) technology with various sensors to track workers' locations, monitor environmental conditions, and ensure quick emergency response. Equipped with sensors like gas detectors, temperature sensors, motion sensors, and GPS, the helmet continuously collects and transmits real-time data to a central monitoring system. In case of dangerous conditions—such as the presence of harmful gases, excessive heat, or lack of movement due to accidents—the system immediately alerts both the worker and supervisors.[1-3]
The mining industry is known for its hazardous working conditions, with risks including explosions, gas poisoning, and accidents. To mitigate these risks, Internet of Things (IoT) technology can be integrated into mining operations to enhance tracking and worker safety.

IoT-based mining tracking involves using sensors, GPS, and other technologies to monitor the location and movement of miners, vehicles, and equipment in real-time. This enables:

1. Real-time tracking: Accurate location tracking of miners, vehicles, and equipment.
2. Automated alerts: Alerts for potential safety hazards, such as gas leaks or equipment malfunctions.
3. Improved resource allocation: Optimized allocation of resources, such as equipment and personnel.[4]

IoT-Based Worker Safety Helmets

IoT-based worker safety helmets are designed to enhance miner safety by providing real-time monitoring and alerts. These helmets can be equipped with sensors to detect:

1. Environmental hazards: Gas levels, temperature, and humidity.
2. Physical hazards: Impact, vibration, and noise levels.
3. Health monitoring: Heart rate, blood pressure, and other vital signs.

These helmets can also include features such as:

1. Two-way communication: Real-time communication between miners and supervisors.
2. Alert systems: Automated alerts for potential safety hazards.
3. Location tracking: Real-time location tracking of miners.[5]

2 LITERATURE REVIEW :-

The concept of an IoT-based mining tracking and worker safety helmet is not attributed to a single inventor or discovery. Instead, it is the result of advancements in IoT (Internet of Things), wireless sensor networks, and industrial safety technologies. Many researchers, engineers, and companies have contributed to its development.

Academic Research – Universities and research institutions have conducted studies on real-time tracking, gas detection, and accident prevention in mining environments.

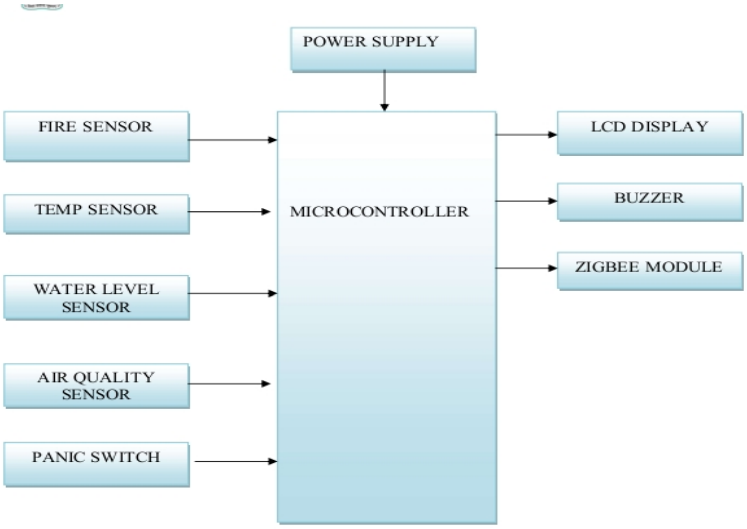
Industrial Safety Companies – Companies specializing in worker safety, such as Honeywell, Siemens, and MSA Safety, have developed smart helmets incorporating IoT features.

Government and Mining Regulations – Many governments and mining organizations have encouraged research on smart safety gear to reduce mining accidents.

Startups and Innovators – Various startups have developed smart helmets with sensors for detecting gas leaks, temperature, humidity, and worker location.IoT Sensors detect gas levels (like methane, carbon monoxide), temperature, and humidity.GPS & RFID track the real-time location of miners.Wireless Communication (Wi-Fi, Zigbee, LoRa, Bluetooth, or GSM) ensures data transmission to a control center.Alerts & Alarms warn workers about potential hazards.[3]

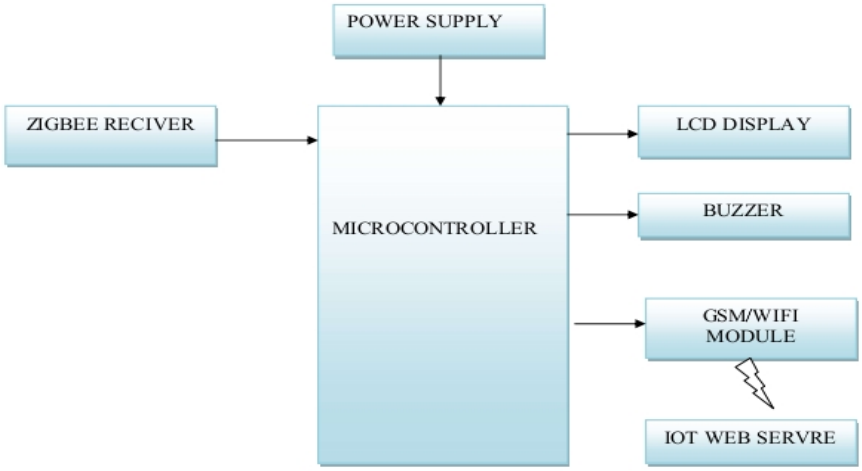
3 ACTUAL METHODOLOGY FOLLOWED :-

Block diagram of mine unit



Block diagram: Mine unit

Block diagram of Basemet unit



In this propose a mining tracking as well as safety system for the mining industry using microcontroller based circuit on the worker helmet. We use rf based circuitry to detect workers moving through the entire mining site. The helmet is integrated with an rf based tracking system which in coordination with the tracker rf systems help provide data over IOT. The system makes use of PIC microcontroller based rf tracker circuitry to receive the data transmitted by worker helmet nodes. This helps map the current location of workers through the entire mining site. Moreover each worker helmet circuit is integrated with a panic/emergency button. This button when pressed shows an emergency sign over the IOT web interface about the worker emergency. This can be used for any emergencies like – toxic gas inhalation, cave ins, physical injury etc. Thus the system ensures mining worker safety using IOT.[2] [4]

3.1 Impact of the project :-

The IoT-Based Mining Tracking and Worker Safety Helmet project has significant impacts in various aspects, including safety, efficiency, and productivity. Here's a breakdown of its potential benefits:

1. Safety Improvements

Real-Time Location Tracking: The IoT system enables real-time tracking of miners, ensuring their whereabouts are known at all times, reducing the risk of being trapped in accidents.

Hazard Detection: The helmet can monitor environmental factors like temperature, gas levels (methane, CO2, etc.), and humidity, alerting workers and management in case of dangerous conditions.

Emergency Alerts: If a miner meets an accident (e.g., fall detection), the system can send emergency alerts to supervisors for immediate assistance.[4]

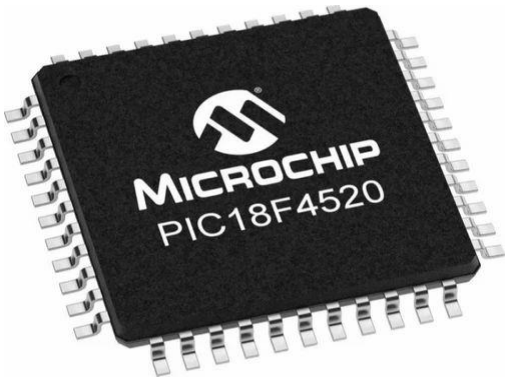
2. Productivity & Efficiency

Optimized Workflow: Supervisors can track workers' movements and optimize their deployment to ensure efficient mining operations.

Reduced Downtime: By predicting hazardous conditions, accidents can be prevented, reducing operational downtime due to injuries or equipment failures.[5]

3.2 Explanation of components

A. PIC18f4520 Microcontroller



- *The Data Memory up to 4k bytesn Data register map with 12-bit address bus 000-FFF*
- *Divided into 256-byte banks*
- *There are total of F banks*

- *Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected-this selection is done via 8-bits*
- *Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.*
- *Program memory stores the program and also static data in the system.*
- *On-chip program memory is either PROM or EEPROM*
- *The PROM version is called OTP (one-time programmable) (PIC18C) The EEPROM version is called Flash memory (PIC18F).*
- *Maximum size for program memory is 2M n Program memory addresses are 21-bit address starting at location 0x000000*

B. Zigbee receiver:

- *Operates on low power, making it ideal for battery-operated devices.*
- *Works on the IEEE 802.15.4 standard.*
- *Supports 20 kbps (868 MHz), 40 kbps (915 MHz), and 250 kbps (2.4 GHz).*
- *Operates in 2.4 GHz, 900 MHz, or 868 MHz frequency bands.*
- *Can connect with multiple nodes (up to 65,000 devices in a network).*
- *Cheaper than other wireless communication technologies like Wi-Fi and Bluetooth for large-scale IoT applications.*

C. GSM module:-

- *Uses cellular networks (2G, 3G, 4G, and LTE) for communication.*
- *Supports voice calls for direct communication.*
- *Supports GPRS (General Packet Radio Service) and EDGE for mobile internet access.*
- *Many GSM modules (e.g., SIM808, SIM7600) come with built-in GPS for location tracking.*
- *Operates on 3.4V–4.4V, making it ideal for battery-powered devices like helmets.*

D. Temp sensor:-

- *Can measure from -50°C to 1500°C (depending on type).*
- *Precision can be ±0.1°C to ±2°C, depending on the sensor type.*
- *Detects temperature changes in milliseconds to seconds.*
- *Some sensors provide analog voltage output (e.g., LM35).*
- *Works with Zigbee, Bluetooth, Wi-Fi, and GSM for real-time data transmission.*
- *Encased in waterproof or rugged materials for use in harsh conditions.*

4 conclusion:-

IoT-based mining tracking and worker safety helmets have revolutionized the mining industry by enhancing safety, efficiency, and emergency response. Research continues to improve sensor accuracy, network connectivity, and AI-based analytics to predict risks. Despite existing challenges, the future of IoT in mining safety looks promising, with advancements in 5G, AI, and blockchain set to redefine worker protection.

5 REFERENCE:-

1] Nisha Dube1, Prof. K.S.Ingle 2 PG Student, Dept. of ECE "Intelligent Mining: A Monitoring and Security System for Coal Mine Workers" , International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 1, January 2016 .

[2]DanielF.Huber NicolasVandapel "Automatic3Dunderground minemapping",The Robotics Institute Carnegie MellonUniversity . The 4th International Conference on Field and Service Robotics, July 14-16, 2003

[3]Warsha M.Choudhari Professor, Datta Meghe, "Coal Mine Security System " International Journal of Applied Information Systems (IJAIS) – ISSN : 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 4– No.10, December 2013.

[4] Prof. Himanshu K. Patel, Deep H. Desai, Tanvi G. Badheka,"GSM Based Flexible Calling System"International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue4- April 2013 .

[5]S.Vandana,PG Scholar,"Development of Coalmine Safety System Using Wireless Sensor Network" Department of Electronics and Communications Engineering Sri Vasavi Engineering College, Tadepalligudem Andhra Pradesh, India ,2012