International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 11 | Nov 2020 www.irjet.net p-ISSN: 2395-0072

Coal Mine Safety & Monitoring by using PLC & SCADA

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Abstract -

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 SCADA system can timely and accurately reflect dynamic situation of staff in the underground regions to ground computer system. The air pollution from coal mines is mainly due to emissions of particulate matter and gases include sulphur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO) etc.

To monitor the concentration level of harmful gases, semiconductor gas sensors are used. Some workers are not aware for safety and they are not wear helmet due to that more accidents occur. Different types of sensors are used in system for the indication of fault occurs in coal mines. The system uses SCADA System for real time data monitoring.

***Key Words*: Programmable Logic Controller, Sensors and SCADA.**

1. INTRODUCTION

The safety issues of coal mines have gradually turned into a major concern for the society and nation. Since 1900, over 100,000 workers have been killed in coal mines in the U.S. and many more have been injured and disabled. Underground coal miners are exposed to a wide range of hazards including gas explosions, shifting rock, falls, and machinery and mobile equipment accidents. Presently miner have only helmet for purpose of protecting the head. In this project we develop a smart system to monitor moisture level and the presence of smoke in coal mines by using SCADA system. To achieve this we are using sensors like smoke sensor, moisture sensor.

If the faults occur in the system then it can be detected by LED's and alarms. Due to breakdown of rope some accidents happen for which sensors are use. This system also provides an early warning, which will be helpful to all miners present inside the mine to save their life before any casualty occurs. Smoke detectors also use to avoid fire in coal mines.

2. LITERATURE SURVEY

Zhenzhen Sun proposed DCS Coal Mine Monitoring System Based on RS485 Bus, RS485 bus structure supports multi-point and two-way communication in 2011.

Tanmoy Maity and Partha Sarathi Das implement a wireless surveillance and safety system for mine workers based on Zigbee in 2012.

Yongping Wu and Guo Feng implement coal mine monitoring using Bluetooth wireless transmission system in 2014.

Yogendra S Dohare and Tanmoy Maity design surveillance and safety system for underground coal mines based on Low Power WSN in 2014.

Pranjal Hazarika presents implementation of safety helmet for coal mine workers. This helmet is equipped with methane and carbon monoxide gas sensor in 2016.

3. REVIEW

3.1 PRESENT SCENARIO

Mining is a renowned for being one of the most hazardous sector in the world due to its complex work environment. Over the years, the directorate general of mines safety, mining companies and academies have made constant efforts to prevent accidents in Indian mines by proposing solutions, improve trainings, advance technology and realiable equipment. The trends of fatal accidents occurring in Indian underground coal mines is higher than USA's and Western Australia's underground coal mines as shown in Fig. 1 and Fig. 2

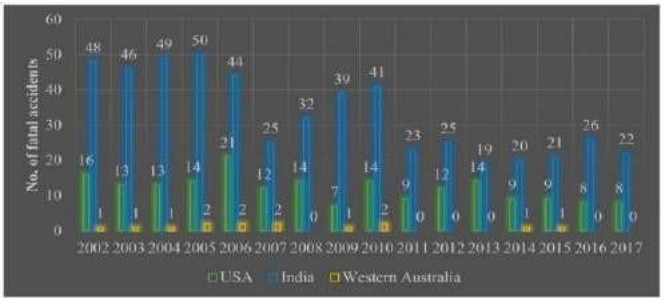

Fig. 1 Comparison of the number of fatal accidents in Indian underground coal mines with the USA and Western Australia.

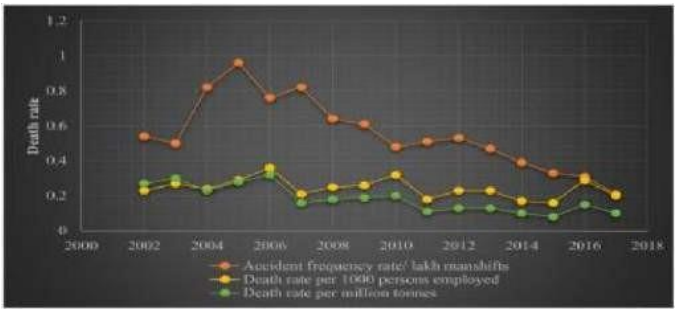

Fig. 2 The trends of different fatality rates in Indian coal mines.

4. PRAPOSED SYSTEM

In this proposed system, a new protection system based on a programmable logic controller (PLC) and supervisory control and data acquisition (SCADA) has been introduced. This system has the ability to control the operation of coal mines and also provides the proper monitoring to control the fault occurrence in the system.

4.1. BLOCK DIAGRAM

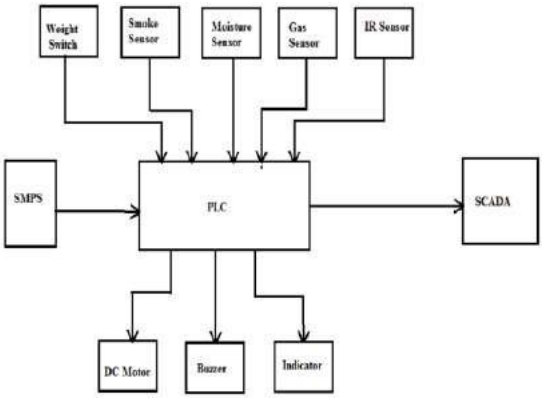

Fig -1: Block Diagram

4.2. WORKING

This system has a sensor module consisting of some sensors that measures real-time underground hazardous condition like harmful gas concentration, moisture level detection, weight sensing and smoke detection. The semiconductor type sensor MQ6 and MQ2 monitor the real-time concentration level of carbon monoxide, sulphur dioxide and nitrogen dioxide respectively and send real time data to the base station. When threshold values of gases exceed the flashing light of sensor is ON.

The Weight Sensor is used if the coal trolley fall down and loses the weight on pulley, weight sensor detects fault is occur and then it gives indications to SCADA system.

The Moisture Sensor is used in coal mines to detect excessive moisture level that will light up a LED at a certain moisture level. It uses SCADA screen for indication.

The working of this sensor can be done by inserting this sensor into the earth and the status of the water content in the soil can be reported in the form of a percent.

4.2.1. PLC

The PLC used here is Delta DVP14SS2 which has 8 digital inputs and 6 outputs which requires 20.4V to 28.8V dc supply for its operation.

4.2.2. RELAY

The relays (Power and Static) used are 24V and 5V dc used for switching action for PLC and to cut-off the power supplied to the loads.

4.2.3. SMPS

The SMPS that used in the system has maximum range of 140-300V input voltage and up to 2A maximum output current. Switched-mode power supply is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently.

4.2.4. SCADA

A SCADA (Supervisory Control and Data Acquisition) system for a power distribution application is a typically a PC-based software package.

5. SOFTWARE DETAILS

5.1 WPL SOFTWARE

The WPL soft is a software which is used to Program Delta PLC. This software was developed to work on Windows XP, Windows Vista, Windows 7, Windows 8 or Windows 10 and can function on 32-bit systems. There are the common names to indicate this program's installer like WPLSoft.exe, Wpl.exe WPL209.exe, WPL208.exe or WPL207.exe.

5.2 WONDERWARE INTOUCH

Wonder ware In Touch it is the award-winning HMI visualization Software.

6. RESULTS

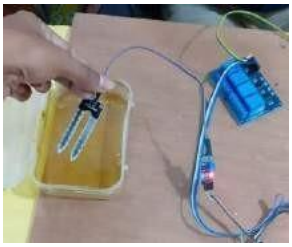

Fig -1: Operation of moisture sensor

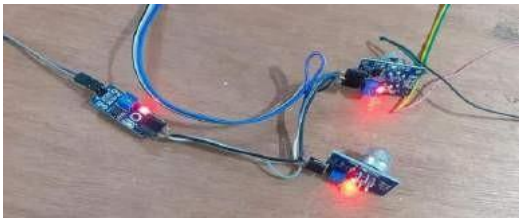

Fig -2: Operation of gas and smoke sensor

7. CONCLUSION

The objective of proposed project is to make the system operation healthy. The system which is implemented is used for safety of workers and easy monitoring. It can monitor the fault occurs in the mines with the help of PLC and SCADA.

8. FUTURE SCOPE

• In future for miner's safety we can use Proximity Sensors and LED for helmet sensing by which we can sense the miner removed helmet or not

• We can use real time monitoring system is developed to provide clearer and more point to point perspective of the underground mine.

9. ACKNOWLEDGEMENT

Sincere thanks to all the researchers for providing such a useful and helpful opinion, findings, conclusions and recommendations. Also gives immense pleasure to thanks to Project coordinator Prof. S. U. Shinde, Principal Dr. N. G. Nikam and friends for their kind support and guidance.

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