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Coal mine safety system using Li-Fi technology

Kolli Pardha Sri Sai Vignesh Naidu
pardhasrisaivignesh@gmail.com
SRM Institute of Science and
Technology, Chennai, Tamil Nadu

P. Visalakshi
visasan2003@gmail.com
SRM Institute of Science and
Technology, Chennai, Tamil Nadu

P. Chervith Chowdary
chowdarychervith@gmail.com
SRM Institute of Science and
Technology, Chennai, Tamil Nadu

ABSTRACT

In this project, we tend to propose a mine safety system that utilizes visible radiation communication technology which that emitting diode lights and a geomagnetic correction technique, which direct towards supporting mine operating people who travel underground. To verify the effectiveness of this system, we conducted an experiment targeting mining people. Although getting correct gas run data and police work voices inside are tough, we confirmed that using this system, accurate voice information, and gas detection can be obtained utilizing Visible Light communication technology which employs LED lights. In this project we are using Visible Light Communication (VLC) system based on white LEDs has emerged as an eco-friendly IT green technology using THz visible light spectrum in the provision of both lighting and wireless access.

Keywords— VLC-Visible Light Communication, LED-Light Emitting Diode.

1. INTRODUCTION

Safety is one of the crucial aspects related to industries peculiarly in the mining industry. In the underground mining process, human safety is the most important thing which we need to look at. Communication is the primary key issue to observe any risky parameter. At present, gold mining workers are affected a lot in accidents at gold mines which is due to the complexity of my environment. So it is indispensable to monitor mine working environment condition. To deflect these damages of life and products, the proper communication system must be used. To improve the safety and production in mines, flexible communication must be established between workers and the higher officials. In the mining process, the wired communication system is not so efficient. Moreover, the installation of the cost of wired connections is very high. These wired connections will fail in natural calamities such as landslides, earthquake etc., so the re-installation cost of the wired networks is also a disadvantage for these connections. Finally, the wired connection requires a lot of maintenance cost also.

2. RELATED WORKS

During the last decade, many traditional systems are used for communication purpose in underground mines. In this section,

we will give a brief description of the most widely used systems. Magneto phones are the oldest crank ringer phones of 20th century operated by DC batteries and AC signals [4]. Paging phones are partially line wired and used for voice communication with no tracking capability. When high voltage trolley line is used for voice communication, then it is called as a trolley carrier phone system [5]. One of the well-known systems of communication for underground mines is; through the earth (TTE) system, which provides alarming, tracking and messaging services by transmitting low-frequency signals to cap lamps, using loop antennas [6]. The biggest drawback for TTE system is the radio wave attenuation, which depends on the frequency of radio wave, earth conductivity, transmission power, antenna type and noise over the surface [7].

The most famous system for underground mines communication is Radio Frequency Identification Device (RFID) system. It is comprised of radio frequency identifier tags, RFID readers, routers and a host station. RFID tags are very small chips capable of storing a specified amount of data in its circuitry. RFID tags area unit of 2 sorts, active and passive. In underground mine application, active tags should be used having the signal range of 100 meters, whereas for passive tags the allowed range is 6-8 meters [9].

In addition to above, there are many wireless systems such as; Wi-Fi (IEEE 802.11), Bluetooth (IEEE 802.15) and Wi-Max used in underground mines application. Ultra Wide Band system is another radio system for short-range communication with very low power and very high data rate [10].

3. SYSTEM ANALYSIS

3.1 System architecture

In order to remotely monitor the minors in the underground, we use gas sensors, temperature sensors. In order to evaluate the gases which are present in the underground, sensors have been used to analyse the amount of hazardous gas and provide an alert message to evaluate the temperature which is present in the underground, the sensor has been used to analyse the centigrade of temperature and provide the alert message.

3.2 Existing system

- Manual operation

- Traditionally, coal mine safety monitoring and automation systems were typically designed to meet the requirements of a single monitoring application.
- Person tracking is very difficult

3.2.1 Disadvantages

- Less secured
- No proper miner monitoring
- Interference of RF signals

3.3 Proposed System

- More secured
- Avoid accidents
- Lifi is used

3.3.1 Advantages

- No interference of RF signal
- Optical output is varied at extremely high speed.
- Unutilized electromagnetic spectrum
- Can be used in more environments
- No health problems
- Illumination and communication

4. BLOCK DIAGRAMS

4.1 Mining area

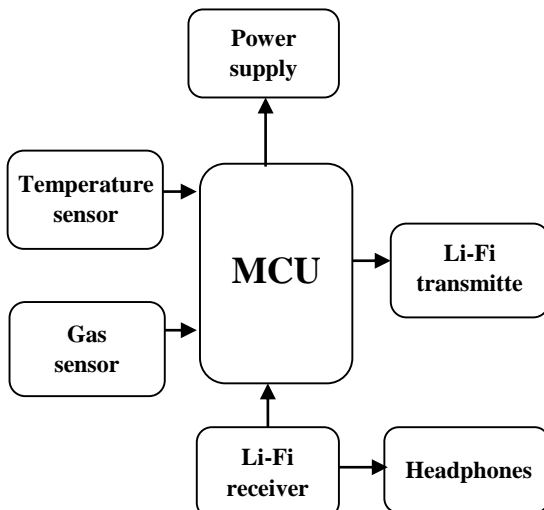


Fig. 1: Mining area

4.2 Control room

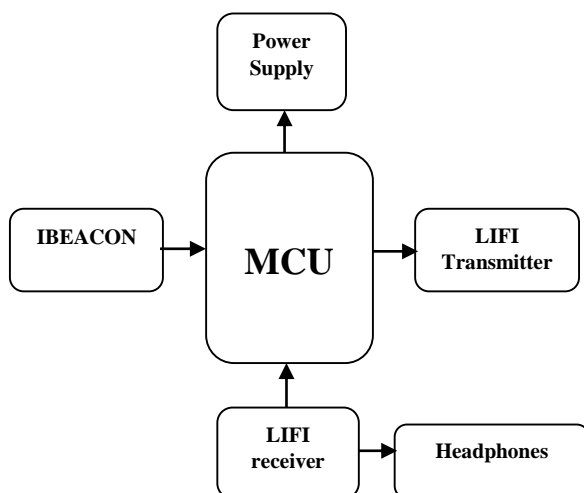


Fig. 2: Control room

5. COMPONENT DETAILS

5.1 Temperature sensor

The LM35 series area unit exactness integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 so has a plus over linear temperature sensors graduated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^{\circ}\text{C}$ at room temperature and $\pm 3/4^{\circ}\text{C}$ over a full -55 to $+150^{\circ}\text{C}$ temperature range. Low value is assured by trimming and standardization at the wafer level. The LM35's low output electrical resistance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It are often used with single power provides, or with plus and minus supplies. As it attracts solely $60\mu\text{A}$ from its provide, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to $+150^{\circ}\text{C}$ temperature range, while the LM35C is rated for a -40° to $+110^{\circ}\text{C}$ range (-10° with improved accuracy). The LM35 series is offered pack aged in tight TO-46 junction transistor packages, whereas the LM35C, LM35CA, and LM35D are offered within the plastic TO-92 junction transistor package.

5.1.1 Features

- Calibrated directly in $^{\circ}\text{C}$ elsius (Centigrade)
- Linear $+ 10.0 \text{ mV}/^{\circ}\text{C}$ scale factor
- 0.5°C accuracy guarantee able (at $+25^{\circ}\text{C}$)
- Rated for full -55° to $+150^{\circ}\text{C}$ range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than $60 \mu\text{A}$ current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only $\pm 1/4^{\circ}\text{C}$ typical
- Low impedance output, 0.1Ω for 1 mA load

5.2 Power supply

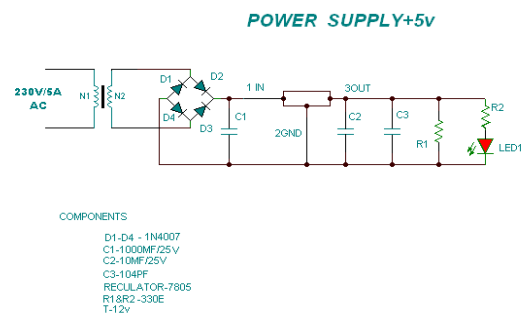


Fig. 3: Power supply

Power supply unit: As we have a tendency to all apprehend any invention of the latest technology cannot be activated while not the supply of power. So it this fast-paced world we have a tendency to deliberately would like a correct power supply which is able to be apt for a specific demand. All the electronic parts ranging from diode to Intel IC's solely work with a DC offer starting from $\pm 5\text{V}$ to $\pm 12\text{V}$. We square measure utilizing for identical, the cheapest and commonly available energy source of $230\text{V}-50\text{Hz}$ and stepping down, rectifying, filtering and regulating the voltage. This will be dealt with briefly in the forthcoming sections.

5.3 Gas sensor MQ-2

In current technology situation, monitoring of gases produced is very important. From home appliances like air conditioners to

electrical chimneys and safety systems at industries observation of gases is incredibly crucial. Gas sensors ad libitum react to the gas gift, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state. The gas device module consists of a steel skeletal system beneath that a detector is housed.

This detector is subjected to the current through connecting leads. This current is thought as the heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the detector that alters the worth of this going out of it. The connecting leads of the sensor are thick so that the sensor can be connected firmly to the circuit and a sufficient amount of heat gets conducted to the inside part. They are cast from copper and have tin plating over them.

5.3.1 Product description: MQ-2 gas device is intended with sensitive material of SnO_2 , which with lower conductivity in clean air. When the target flammable gas exists, the sensor's physical phenomenon is higher. Signal learning circuit is employed to convert the amendment of physical phenomenon to correspond signalling with the input gas concentration. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application. The MQ-2 gas module is:



Fig. 4: Gas sensor MQ-2

5.4 Arduino

The Arduino Uno could be a microcontroller board supported the ATmega328 (datasheet). It has fourteen digital input/output pins (of that half dozen is used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything required to support the microcontroller; merely connect it to a pc with a USB cable or power it with AC-to-DC adapter or battery to induce started. The Uno differs from all preceding boards in this it does not use the FTDI USB-to-serial driver chip. Instead, it options the Atmega8U2 programmed as a USB-to-serial converter.



Fig. 5: Arduino

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V

- Digital I/O Pins fourteen (of that half dozen give PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory thirty-two K of that zero.5 K utilized by boot loader
- SRAM 2 KB
- EEPROM 1 KB
- Clock Speed 16 MHz

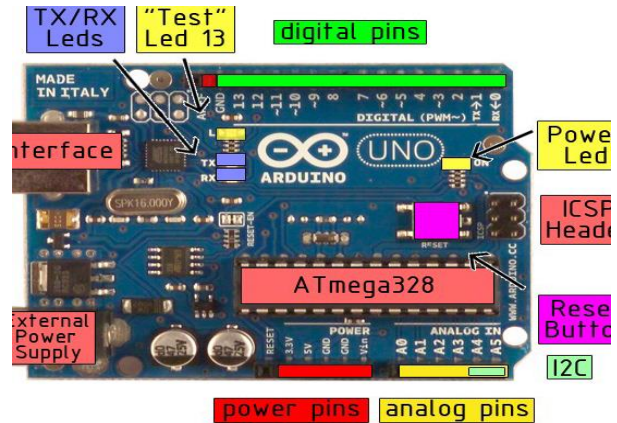


Fig. 5: Arduino

Arduino Uno is battery-powered via the USB association or with associate external power offer. The power source is selected automatically. External (non-USB) power will come back either from associate AC-to-DC adapter (wall-wart) or battery. The adapter is connected by plugging a pair of 1mm centre-positive plug into the board's power jack. Leads from the electric battery are inserted within the Gnd and VIN pin headers of the ability connexion. The board will treat associate external offer of half a dozen to twenty volts. If equipped but 7V, however, the 5V pin may provide but 5 volts and also the board is also unstable. If exploitation over 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

VIN: The input voltage to the Arduino board once its exploitation associate external power supply (as critical five volts from the USB association or alternative regulated power source). You can offer voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. 5V. The regulated power offers accustomed power the microcontroller and alternative parts on the board. This can come back either from VIN via an associate on-board regulator, or be supplied by USB or another regulated 5V supply. 3V3. A 3.3 potential unit offer generated by the onboard regulator. Maximum current draw is 50 mA. GND. Ground pins.

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