

## A NEW ALERTING SYSTEM FOR CONFINED ENVIRONMENT USING VISIBLE LIGHT COMMUNICATION

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**Abstract:** Visible light communication, the new way of communication through lights. Visible light communication can create new era in communication without using the electromagnetic waves in blind areas and underground environments. This enables the communication in all places and offers some advantages over wifi. The perks are low energy usage and availability of spectrum i.e. (430-790) THz. This also include small equipment and high speed data connections. The previous communication methods used underground using the radio waves are poor due to unstable data rates and less availability of frequencies. This reasons make the methods danger to use in underground as better communication is required for health and safety. [10]In this paper we try to introduce the visible light communication to overcome the issues and for better safety alerts. The deaths in underground mining are high due to improper alerting system which is lacking due to the communication problems. The communication channels are modeled accounting the shadowing effects and dust effects in mines. The enabling of all way communication using the lights help the people to communicate with themselves so that the threat alert reach the workers fast. The proposed system will be showing significantly high data rates in small areas.

### 1. INTRODUCTION

[8]The workers in the confined areas like the mining and radiation vulnerable places are given instructions to work by the law following the safety measures. This is to reduce the probability of accidents and death causing. The technology has been widely developing day to day and many of those were adopted in order to avoid the accidents. Mining and confined areas with less probability for communication through radio waves make them the most dangerous place to work in. over the decades the mankind has witnessed many accidents and deaths in those places. Some of the serious problem which are taken into account are chemical gas leakage, rising of temperatures, cave-in, gas explosions, fires and short circuits etc. These circumstances lead to

many fatalities. The proper warning and help must be provided in such conditions as fast as possible.

The technologies being used since many years both wired and wireless served better but lacking in avoiding the accidents to good extent. Some of the reasons they are lacking in are electromagnetism, consumption of more electronic energy for WLAN, infrared systems which are harmful to the working staff and higher costs.

[2] Latest technology visible light communication has come into spotlight. This is due to the possibility in both indoor and outdoor. And the other good reason is the higher data rates in the smaller areas. The method is recognized as a safe one as there will be no electromagnetic interference and the other reason is it is open to use without license. The technology is perfect for confined areas, buildings, underground areas and hospitals.

The lighting is essential in all working environments and they are already installed. The spectrum available for the visible light communication is much higher than the radio wave communication. The incandescent and fluorescent lamps are used in all places usually. They do offer the visible light communication but the usage of LED's (Light emitting diodes) improve the communication. The LED's which are very small and consume less energy compared to other lights. The LED's we used in here are of 1 Watt which have the intensity of 60-100 lumens theoretically. But the lumens vary as the message through the light will be digital and the message will never be stable. The LED's will be undergoing the action of on-off keying at very high speed. They are not even visible to our naked eye. The more speed they flicker represent the more data speed. The working of VLC communication in mines will be undergoing through the technique called intensity modulation and direct detection (IM/DD). The channel of communication is modified to overcome the disadvantages like the shadowing effects and other interference of lights.

The rest of the paper goes describing other types of communication used in the underground or confined areas, proposed system and conclusions.

## 2. OTHER SYSTEMS USED

[7] The other communications used in the confined environments will include WiFi and radio wave communication, magneto phones and pagers.

The magneto phones are ringer type phones from olden days and which are worked with DC batteries and AC signals.

Pagers are one of the most popular type of communication. The pagers are modern and they operate usually with the individual pager number. The data rates are good and this communication requires wires. This system is followed by the 'Through the earth' system which requires a lot of ground work.

Then comes the wireless communication like Bluetooth, RFID and many other types. Radio Frequency Identification Device consists of RFID readers, routers and hub station. In addition to above, there are many wireless systems such as WiFi (IEEE 802.11), Bluetooth (IEEE 802.15) and WiMax used in underground mines application.

### 3. PROPOSED SYSTEM

**Starting with the system:** [1][3]The proposed system consists of lights which are essential in all places and already installed. So the system is easy to install and no need separate sources. It consists of lifi audio transmitter and lifi audio receiver. The voice in this project is considered one of the important task as the threat alerts are given in the form of voice. The voices must be individual for each alerting. The sensors play a key role in helping the voice board to give the commands to the lifi audio transmitter. The voice is given using the voice board. The voice board we use is 8 channel voice board which can record 8 types of voice channels and play them likewise. It works on principle of high and low signals. It records or plays when the signal is high.

The microcontroller we use helps us to interface the voice channel board, lifi audio transmitter and receiver. The sensors can be used based on the type of environment and type of element is being mined.

**Sensors and interfacing:** In general the major accident cause is being noticed due to leakage of poisonous gases and high amount of temperature. Considering the issues and detection of the same will help workers. The temperature sensor which can detect the temperatures from -55 to 150 degrees centigrade is interfaced with the system and to be programmed for detecting the particular temperatures. The temperatures in the underground are different from usual temperatures. The temperatures will be around 45 to 50 degrees centigrade which are cooled

down to 28 degrees with the help of coolers. So based on that survey the temperature range is set from 35-40 degrees for the alerting system.

[5]The gas sensor will have the same thesis for the programming. The human body needs good percentage oxygen for proper respiration. When we go underground the percentage of oxygen will be less in the atmosphere compared to outside levels. The percentage will be 17-18. The gas sensor will be able to sense all kinds of gases which aren't the normal gas for human body. When the oxygen level is below 17% the human can't have normal breathing. Earlier they used the lanterns which get turn off automatically when the oxygen levels are less. The system is vulnerable as some gases are capable of catching the flame. The gas sensor will help the issue.

[4]The sensors which are used are interfaced with the microcontroller using the pin configuration of microcontroller and the IC's of LiFi transmitter and receiver.

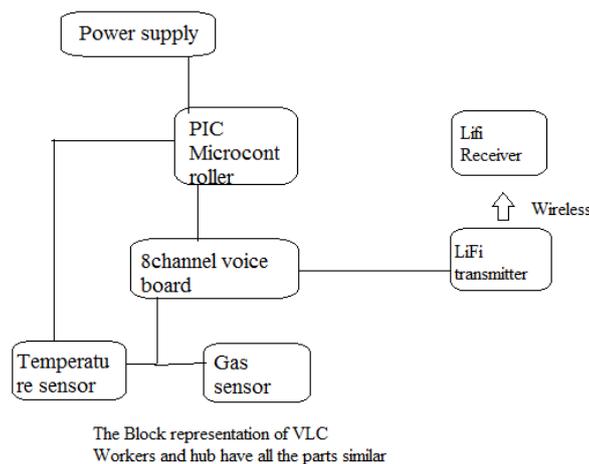


Figure 1: Block diagram

**Initialization of process:**

The procedure will start from the primary sensors to the detection. The miner's lights are used as the receiver and transmitter. [6]The sensors sense the threat and give the data to the voice board and the board having 8 channels transmits the voice of particular assigned voice in the form of digital data through the LiFi transmitter. The transmitter have the LED's which are arranged either in serial or parallel start flickering and helps to transfer the data.

The LiFireceiver have the Photovoltaic module so that small light can get the data. The shadowing effects are reduced to great extent with the help of this module. The arrangement of lights in either serial or parallel can have good results but arranging them in parallel can make the LED's to have different type of flickering making the data transmissions to higher rates. The worker unit will have the lights as wells as receiver so that they can receive the alerts and give them as well preventing the delay in alerts. The hub maintains all the messages and general intimations including the alerts. This all way communication adds the feature of getting the alert to the hub and other worker as well.

**Results:**

[9]The radio frequencies are higher from 3 kHz to 300GHz and wavelength of 1millimetre to 100 kilometers but the penetration capability will be less when it goes to underground and the waves from tower outside cannot reach the underground. The average speeds in underground parking places which has perfect geometry is 200kbps. The underground working environment which is uneven and thicker walls has speeds less than 50kbps. The speeds are inefficient. The proposed system has increased the speed from 50kbps to 20mbps. The data speed delay is less than 2 milliseconds due to fast flickering.

**4. CONCLUSIONS**

The system is being established with the moto of giving the alerts swiftly and reduces the accidents. The system uses the lights which are installed in the working environment and the miner helmets as well. This reduces the cost of installation to great extent. The spectrum available for the communication through the lights is thousand times greater than the spectrum available for radio wave communication. The communication is possible in all kinds of areas which isn't possible by radio communication. Visible light communication helps to attain high data rates at smaller areas which also helps in continuous monitoring of the area. This system have very less cost and the very secured as the system is hack proof. The all way communication helps in giving the alerts very quickly. When we try to draw good conclusions and results we do have some drawbacks.

**DRAWBACKS:**

The system is built on lights for communication. So the lights have to be replaced in regular intervals for good results. As we use the lights present in the working environment the people

will be moving making the shadows of them stopping the light. Light cannot travel through the opaque objects. This makes the communication to halt for some seconds. Modulation helps to overcome it but we do have some problems. The other drawback is the light not travelling to long distances. The VLC is possible to only limited distance earlier. But now the market is with full of good lights with high power to make the lights available for long distance transmission. The challenge comes with choosing the good light and also lights which shouldn't affect the eyes of the worker.

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