A Novel Approach for Fast Data Transmission and Data Confidentiality Using Li-Fi Technology

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ABSTRACT

We provide with the solution for the problem in the gold mining and oring processes. Gold mining and oring involves the science, technology, and business of the discovery of gold, in addition to its removal and sale in the marketplace. Most injuries underground involve falling rock, slips, and explosions. Toxic gas is emitted during the time of mining and oring processes. The mining workers were affected by lung disease by inhaling dust and toxic gas in Gold mining environment. This proposed system monitors toxic gas in the environmental, forecasts the changes in gold mining using multiple sensors. Light fidelity (Li-Fi) technology is introduced to forecast the monitored data. In this Light fidelity technology, we can data transmission and reception in a hazard less manner.

Keywords—*Light Fidelity, Toxic Gas, Oring, Data Transmission, Data Reception*

1. INTRODUCTION

Wi-Fi technology becomes more popular today. Every public spots and private offices have Wi-Fi because of this wireless spectrum is blocked very frequently. Due to maximum utility RF interferences are getting more common to overcome this problem light fidelity (Li-Fi) technology was introduced in the year 2011. Li-Fi is similar to other wireless communication which uses the communication medium as light. Visible light is use to transfer data between the system instead of radio signals. Li-Fi uses LED light source to transmit the data wirelessly this method is widely called as VLC (visible light communication). A stream of data transmitted in the way of pulses of light that cannot be detected by the naked eye. By using the Li-Fi technology many improvements are done in the field of automation. In this work the Li-Fi is used for smart home where the data's of the sensors are obtained and transmitted to the other end with the help of visible light.

The data is sent in the way of light rays that has been generated using LED light source the intensity of the light source as been increased by reducing the amplitude of the digital data that as to be transmitted. The components used into the Li-Fi communication purposes are Led lights or florescent light source and the photo detector. A photo detector can be used to receive the transmitted data from the light source and generates the original data. In this we are proposing a safety system for the mining workers to avoid minor or major accidents and to save the life of the workers. The CH4 sensor is used to sense the level of methane gas present in the mine and to intimate the officials about the presence of hazardous gas. If so found it can be indicated by an alarm and if the level

exceeds it can be exhausted by use of an exhaust fan. The pulse-oxi is used to monitor the heartbeat of the worker and these data's are transmitted to the monitoring section through VLC. In the gold oring process the toxic level is sensed by pH sensor and displayed in the LCD and if the toxic level exceeds the threshold value the Sodium Meta Sulphate solvent is sprayed over the area to neutralize the toxic level. The obtained data is transmitted by the visible light and received by the photo detector at the receiver end and then it is transmitted to the PC and monitored at the receiver section. The above work is done to enhance the safety for the mining workers.

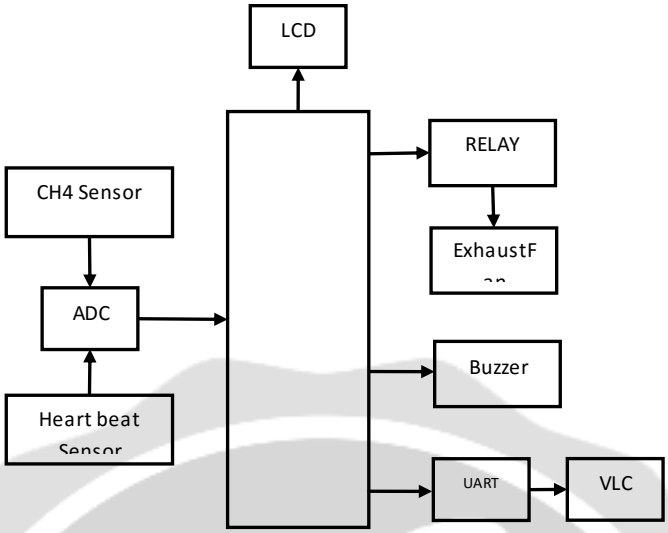
2. LITERATURE SURVEY

Serhan Yarkan, Sabih G¨uzelg¨oz, H¨useyin Arslan, and Robin R. Murphy[1] proposed that After a recent series of unfortunate underground mining disasters, the vital importance of communications for underground mining is underlined one more time. Establishing reliable communication is a very difficult task for underground mining due to the extreme environmental conditions. Until now, no single communication system exists which can solve all of the problems and difficulties encountered in underground mine communications. However, combining research with previous experiences might help existing systems improve, if not completely solve all of the problems. In this survey, underground mine communication is investigated..M. Donoghue[2] described that the physical, chemical, biological, ergonomic and psychosocial occupational health hazards of mining and associated metallurgical processes. Mining remains an important industrial sector in many parts of the world and although substantial progress has been made in the control of occupational health hazards, there remains room for further risk reduction. Kiran Lakkaraju, William Yurcik and Adam J. Lee [4] described that The number of attacks against large computer systems is currently growing at a rapid pace. Despite the best efforts of security analysts, large organizations are having trouble keeping on top of the current state of their networks. In this paper, we describe a tool called NVisionIP that is designed to increase the security analyst's situational awareness. As humans are inherently visual beings, NVisionIP uses a graphical representation of a class-B network to allow analysts to quickly visualize the current state of their network. We present an overview of NVisionIP along with a discussion of various types of security-related scenarios that it can be used to detect. Sarah Vieweg, Amanda L. Hughes, Kate Starbird & Leysia Palen[5] analyzed the microblog posts generated during two recent, concurrent emergency events in North America via Twitter, a popular microblogging service. We focus on communications broadcast by people who were "on the ground" during the Oklahoma Grassfires of April 2009 and the Red River Floods that occurred in March and April 2009, and identify information that may contribute to enhancing situational awareness (SA). This work aims to inform next steps for extracting useful, relevant information during emergencies using information extraction (IE) techniques.

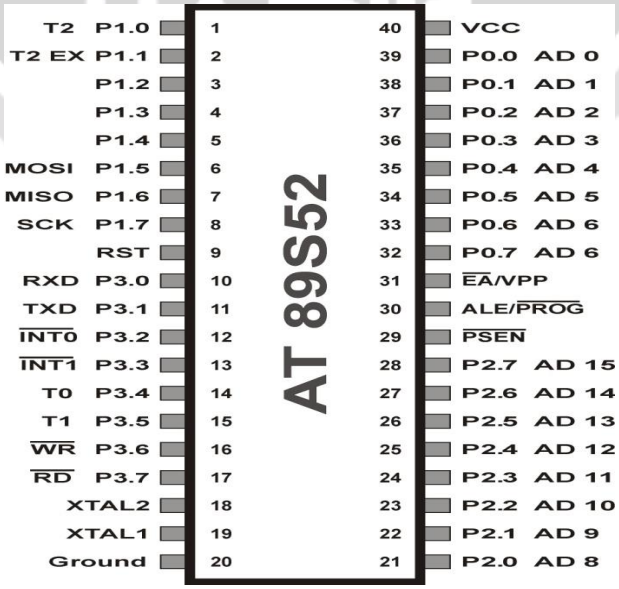
3. SYSTEM ARCHITECTURE

Humankind has been utilizing light as a communication medium for many years, and light continues to be of great benefit in the field of communication. Fire has been used to make smoke signals on clouds; that is a kind of visual communication. After the invention of the electric light bulb by Thomas Alva Edison in the 19th century, new ways were developed to use light to communicate. The invention of the electric bulb led to the invention of the Signal Lamp, a visual signaling device used for optical communication invented by Arthur C. W. Aldis. Typically, the Signal Lamp uses Morse code to give information to the observer by making shutters mounted on the front of the lamp open and close.

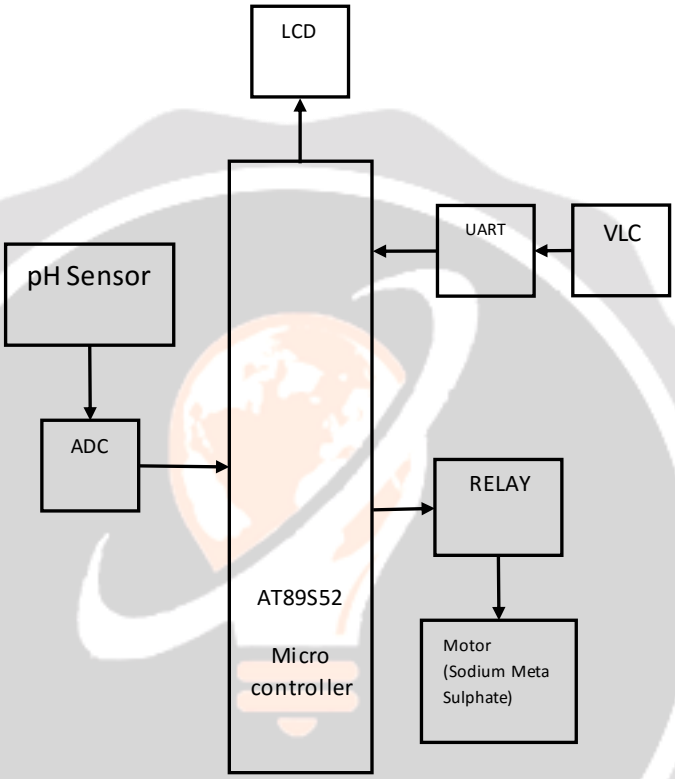
The mining section consists of the following main components. CH4 Sensor, Heartbeat sensor, ADC, AT89S52 microcontroller, LCD display, Exhaust fan and VLC transmitter.



The AT89S52 is a low-power, high-performance CMOS 8-bit micro controller with 8K bytes of in-system programmable Flash memory. It is completely compatible with MSC-51 products. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory pro-grammars. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.



The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized comparator, a256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE outputs.



A pH meter measures the potential difference (in mV) between the electrodes and converts it to a display of pH.In order to obtain a correct measurement, the input amplifier and the converting circuit must meet certain requirements. The potential difference between the reference electrode and the glass electrode is amplified in the mV amplifier before the A/D converter feeds the signal to the microprocessor for result calculation. As the glass electrode typically has an inner resistance of the order of108Ω, the amplifier's input resistance, Ri, must be considerably higher. A value of 1012 is required. For the same reason it is also important that the amplifier does not send any current through the glass electrode as this will give an error potential and could even disturb the electrode. The output is a digital signal for the numeric display. In a digital pH meter, the amplifier works under the same conditions all the time and is directly connected to an A/D converter.
The measured voltage can be expressed by the Nernst equation in the following way:

E = Eind - Eref = E'T - R • T/F • ln aH+
Where,
E = Measured voltage (mV)
Eind = Voltage of indicator electrode (mV)
Eref = Voltage of reference electrode (mV)
E'T = Temperature dependent constant (mV)
R = Gas Constant (8.3144 J/K)
T = Absolute Temperature (K)
F = Faraday's constant (96485 C)

The buzzers used are FDK piezoelectric buzzers generate sound through the bending vibrations of a thin metal plate adhered to a piezoelectric element. These buzzers feature low power consumption, a safe, spark-free and non-contact structure, and a small size and light weight for an easy mounting to printed circuit boards.

A relay is an electrical switch that uses an electromagnet to move the switch from the off to on position instead of a person moving the switch. It takes a relatively small amount of power to turn on a relay but the relay can control something that draws much more power. The VLC component of the device simply converts these signals into light signals based on ON-OFF encoding.

CPU is a unit which monitors and controls all processes within the microcontroller and the user cannot affect its work. It consists of several smaller subunits, of which the most important are: Instruction decoder is a part of the electronics which recognizes program instructions and runs other circuits on the basis of that. The abilities of this circuit are expressed in the "instruction set" which is different for each microcontroller family. Arithmetical Logical Unit (ALU) performs all mathematical and logical operations upon data. Accumulator is an SFR closely related to the operation of ALU.

It is a kind of working desk used for storing all data upon which some operations should be executed (addition, shift etc.). It also stores the results ready for use in further processing. One of the SFRs, called the Status Register, is closely related to the accumulator, showing at any given time the "status" of a number stored in the accumulator (the number is greater or less than zero etc.). A bit is just a word invented to confuse novices at electronics. Joking aside, this word in practice indicates whether the voltage is present on a conductor or not. If it is present, the appropriate pin is set to logic one (1), i.e. the bit's value is 1. Otherwise, if the voltage is 0 V, the appropriate pin is cleared (0), i.e. the bit's value is 0. It is more complicated in theory where a bit is referred to as a binary digit, but even in this case, its value can be either 0 or 1.

The idea of using light as a communication medium was implemented by Alexander Graham Bell in 1880 with his invention of the photophone, a device that transmitted a voice signal on a beam of light. Bell focused sunlight with a mirror and then talked into a mechanism that vibrated the mirror. The vibrating beam was picked up by the detector at the receiving end and decoded back into the voice signal, the same procedure as the phone did with electrical signals. But Bell could not generate a useful carrier frequency, nor was he able to transmit the light beam from point to point. Obstacles in nature such as fog and rain — which could interfere with the photophone — made Bell stop any future research into his invention.

With the invention of LED (Light Emitting Diode), the idea of using light as a communication medium has started again. VLC uses white Light Emitting Diodes (LED), which send data by flashing light at speeds undetectable to the human eye. One major advantage of VLC is that we can use the infrastructure around us without having to make any changes to it. LEDs' ability to transfer information signals over light (light which is between 400THz to 800THz of frequency and whose wavelength is between 400nm to 700nm) makes it a very good communication medium. Now the light we use in our daily life can not only be used for providing light but also for communication.

Timers use most programs which use these miniature electronic "stopwatches" in their operation. These are commonly 8- or 16-bit SFRs the contents of which are automatically incremented by each coming pulse. Once the register is completely loaded, an interrupt is generated! If these registers use an internal quartz oscillator as a clock source, then it is possible to measure the time between two events (if the register value is T1 at the moment measurement has started, and T2 at the moment it has finished, then the elapsed time is equal to the result of subtraction T2-T1). If the registers use pulses coming from external source, then such a timer is turned into a counter. This is only a simple explanation of the operation itself. It's somehow more complicated in practice.

Programs implemented are different here, unlike other integrated circuits which only need to be connected to other components and turn the power supply on; the microcontrollers need to be programmed first. This is a so called "bitter pill" and the main reason why hardware-oriented electronics engineers stay away from microcontrollers. It is a trap causing huge losses because the process of programming the microcontroller is basically very simple. In order to write a program for the microcontroller, several "low-level" programming

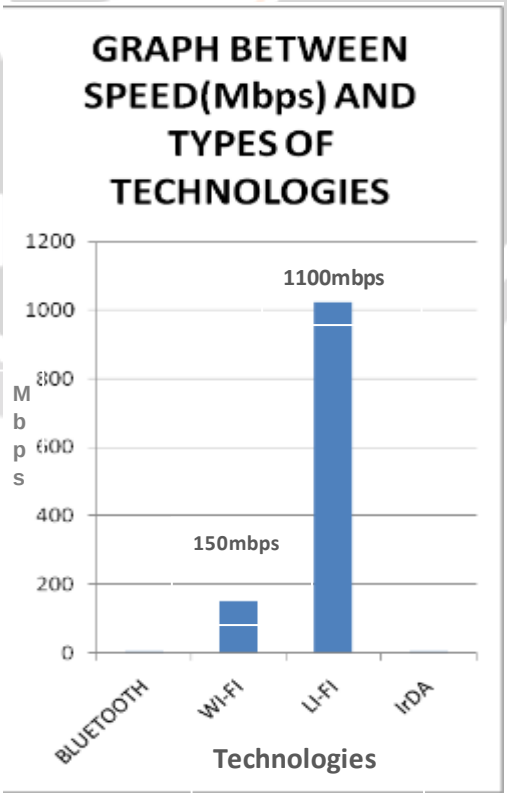
languages can be used such as Assembly, C and Basic. Writing program procedure consists of simple writing instructions in the order in which they should be executed.

Interrupt - electronics is usually faster than physical processes it should keep under control. This is why the microcontroller spends most of its time waiting for something to happen or execute. In other words, when some event takes place, the microcontroller does something. In order to prevent the microcontroller from spending most of its time endlessly checking for logic state on input pins and registers, an interrupt is generated. It is the signal which informs the central processor that something attention worthy has happened.

As its name suggests, it interrupts regular program execution. It can be generated by different sources so when it occurs, the microcontroller immediately stops operation and checks for the cause. If it is needed to perform some operations, a current state of the program counter is pushed onto the Stack and the appropriate program is executed. It's the so called interrupt routine. Stack is a part of RAM used for storing the current state of the program counter (address) when an interrupt occurs. In this way, after a subroutine or an interrupt execution, the microcontroller knows from where to continue regular program execution. This address is cleared after returning to the program because there is no need to save it any longer, and one location of the stack is automatically available for further use. In addition, the stack can consist of several levels. This enables subroutines' nesting, i.e. calling one subroutine from another

4. COMPARISON OF Wi-Fi WITH Li-Fi:

Studies show that Wi-Fi being the fastest transfer known to a common man provides a high data transfer rate and quick implementation speed. But in Li-Fi the data is transferred through the speed of light which is faster than the normal data transfer rate in the Wi-Fi transmission. Li-Fi can be used in a normal environment. But in an environment which emits toxic gases the Wi-Fi provides a radiation which combines and provides a highly dangerous toxic emission that would affect the human life present in the surrounding as well as the people coming in contact. So to avoid this endangering effect, we provide with Li-Fi transmission and also provide with a method of transmission that doesn't affect any human personal who comes into contact with the gas or with any other human.



This graph provides with the illustrated graph which compares with various wireless technologies that provide transfer and it is compared with Li-Fi technology. Here we can see that the transfer rate of various technologies varies in a huge scale that Li-Fi transfer is much faster and efficient and the next comparative transfer is only seen in Wi-Fi.

5. MODULES DESCRIPTION:

MODULE 1:CH_4 SENSOR

This component in the mining section is used to detect elevated levels of methane or other toxic gases in the local environment. Upon detection it sends a signal which activates the buzzer and the exhaust fan set up. The buzzer alerts the workers to the presence of toxic gases in the air and the exhaust fan helps to keep the toxicity in the air to a tolerable level while the workers evacuate the premises. The CH_4 sensor senses the intensity of the gas that is exerted on the location and sends the signal through light to the receiver, which in turn causes the buzzer to ring when the intensity is high. When the intensity and the toxicity is low in the exerted gas the values of the gas reduces and provides with a nominal value of output for calculation.

MODULE 2: HEARTBEAT SENSOR

The heartbeat sensor is attached onto each individual worker and constantly monitors their pulse rate. The model we use in the project for demonstration is hardwired to update the recorded pulse rate if it is consistent for 10 ticks, if not it waits till it gets a consistent reading to give an accurate value. In the prototype if the heartbeat drops or rises above the threshold levels, it will activate the buzzer. In the real time implementation the heartbeat sensor is attached to the user with an emitting LED light the illuminates with a supercharged battery for getting the heartbeat of the worker every 1 minute. When the heartbeat spikes more the 72 beats per minute and if it is more than 72, the buzzer appears to ring indicating that the person is under danger circumstances.

MODULE 3: pH SENSOR

The pH sensor in the oring components is used to detect any residual toxic components released when the gold is extracted from the ore. The tolerance level of pH for human skin is 6-8. Anything higher or lower will cause discomfort and in extreme cases, rupturing, bleeding and permanent damage. The pH sensor is moduled with 2 subsequent rods that are inserted into the rocks which contains with gold and toxic gases. This detects the toxic gases and provides with the value that it needs to trigger the buzzer.

MODULE 4: TRANSMITTER AND RECEIVER UNIT

The transmitter unit converts all the data collected from the various sensor units and transmits it to the receiver via visual light communication and received using photo diode.It converts the electrical signals into light signals by use of on-off encoding and utilizes the baud rate frequency which is preset into both receiver and transmitter to ensure data confidentiality. The transmitter is connected to the LED lamp which emits the light to the receiver. Here the lamp is illuminated by a high intensity lamp which assigns the frequency and transfers to the receiver that has the same frequency.

6. EFFICIENCY OF THE SYSTEM

In an area covered by a single Wi-Fi access point, we generally use 10-100 light sources. If we were to use the Li-Fi transmitter in these light sources we can provide a area of 10 to 1000 times more coverage in place of the Wi-Fi terminal. We do this with the power that is already being consumed by the light sources and avoid the power consumption by the Wi-Fi equipment. Through the use of wavelength and optical filtering we are able to avoid the interference of light from other sources such as the sun and other ambient light. These filters are implemented on the side of the receiver on the photo diode. Also by using multiple access we are able to provide a network where a user may be able to move from one light source to another without loss of data through use of hand over. This is the main advantage and difference Li-Fi over FSO (Free Space Optics) which uses IR signals which is solely based on Line Of Sight technology whereas Li-Fi can rely on multi path propagation where the signals do not negate each other but rather add to each other. Also since the light signals are confined to one room this coverage draw back also doubles as a security advantage where hackers are not allowed access to the signals.

7. SYSTEM IMPLEMENTATION

Li-Fi being implemented in the field of mining for safety of the workers is especially effective since the mine shafts is a closed space and nearly no ambient light or natural light sources are available and a large amount of artificial light sources are required to be installed. We can utilize these light sources for our network and due to the absence of other light sources, we do not need to invest much in optical or wavelength filters. Also since the mineshafts will not be more than 10-20 feet in length, we light intensity required is quite low allowing us to consume less power. Hence in our set up we demonstrate the working of the modules and communication of up to 10 feet in a closed environment.

8. CONCLUSION

Our project provides safety system for Gold Mining persons using Visible Light Communication. Li-Fi (Light Fidelity) as a fast and cheap optical version of Wi-Fi. The main components of this communication system are high brightness white LED, Which acts as a communication source and silicon photo diode which shows good response to visible wavelength region serving as the receiving element. Here CH_4 sensor is used to sense the level of methane gas present in the mine and to intimate the officials about the presence of hazardous gas. If so found it can be indicated by an alarm and if the level exceeds it can be exhausted by use of an exhaust fan. The Heart beat sensor is used to monitor the heart beat of the worker and these data are transmitted to the monitoring section through VLC. In the gold oring process the toxic level is sensed by pH sensor and displayed in the LCD and if the toxic level exceeds the threshold value the Sodium Meta Sulphate solvent is sprayed over the area to neutralize the toxic level. The obtained data is transmitted by the visible light and received by the photo detector at the receiver end. The above work is done to enhance the safety for the mining workers.

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