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A Smart Protective Head Gear for Air Quality and Precarious Freak Exposure in the Collier Industry

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Abstract:
A smart system is being proposed here, that is able to detect and evaluate air quality (Toxic gases) and Hazardous events in the underground collier industry. It gives a new method of analysing precarious freaks happening in the mining such as carbon dioxide, sulphur dioxide, nitrogen dioxide and other toxic gases and the another dangerous event was classified as a miner removing the helmet off their head. IR sensors were then used to determine if the helmet is on miner's head. The another main hazardous event is defined as an event where the miners are stuck by an object against the head with a force. An accelerometer was used to measure the proper acceleration of the head and the HIC was calculated in software. This system is developed with PIC microcontroller apart from this the proposed system will indicate the helmet position on the person as well as any external input on the helmet and, To measure these events suitable sensors are used; will collect the information from the underground mining interfacing with PIC microcontroller with IOT transmitting unit, then send to the IOT monitoring unit. This system will provide the early warning or information to the miner, which it is helpful to all miners to save their life before something happens.

Keywords: Miners, Safety, Sensors, Wireless Network.

I. INTRODUCTION

A smart system is being proposed here, that is able to detect and evaluate air quality (Toxic gases) and Hazardous events in the underground collier industry. It gives a new method of analysing precarious freaks happening in the mining such as carbon dioxide, sulphur dioxide, nitrogen dioxide and other toxic gases and the another dangerous event was classified as a miner removing the helmet off their head. IR sensors were then used to determine if the helmet is on miner's head. The main hazardous event is defined as an event where the miners are stuck by an object against the head with a force. An accelerometer was used to measure the proper acceleration of the head and the HIC was calculated in software. This system is developed with PIC microcontroller apart from this the proposed system will indicate the helmet position on the person as well as any external input on the helmet and, To measure these events suitable sensors are used; will collect the information from the underground mining interfacing with PIC microcontroller with IOT transmitting unit, then send to the IOT monitoring unit. This system will provide the early warning or information to the miner, which it is helpful to all miners to save their life before something happens.

II. PROPOSEDMETHOD

- The hazardous events were classified as a miner removing the mining helmet off their head.
- A smart mining helmet was developed that is able to detect three types of hazardous events such as danger level of hazardous gases, miner helmet removing, and collision or impact
- IR sensors are used because; An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.
- The visible spectrum at 700 nanometers (nm) to 1 millimeter (mm). This range of wavelengths corresponds to a frequency range of approximately 430 THz down to 300GHz.
- Vibration sensors are sensors for measuring, displaying, and analyzing linear velocity, displacement and proximity, or acceleration.
- More accurate
- As opposed to WiFi, it's a mesh networking standard, meaning each node in the network is connected to each other.
- So, The ZigBee technology is designed to carry small amounts of data over a short distance while consuming very little power.

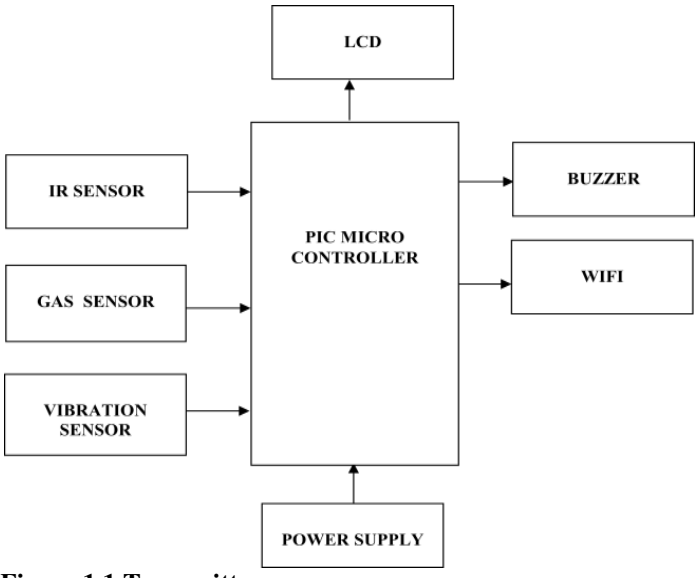

Figure.1.1.Transmitter

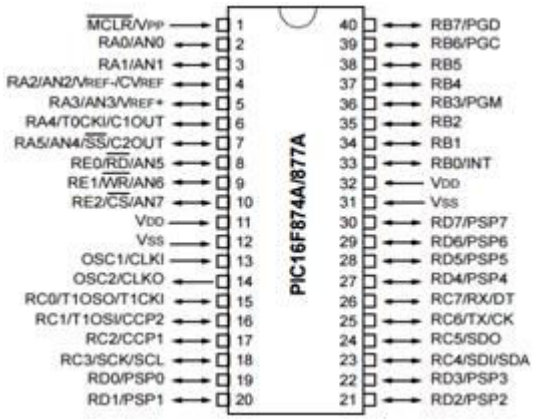

Figure.1.2.Pic Microcontroller

PIC microcontrollers are a family of specialized micro controller chips produced by Microchip Technology PIC stands for "peripheral interface controller. Early models of PIC had read-only memory or field- programmable EPROM for program storage, some with provision for erasing memory. All current models use flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long. The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions. The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high- speed variations exist for many types.

IR SENSOR

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received. When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram.

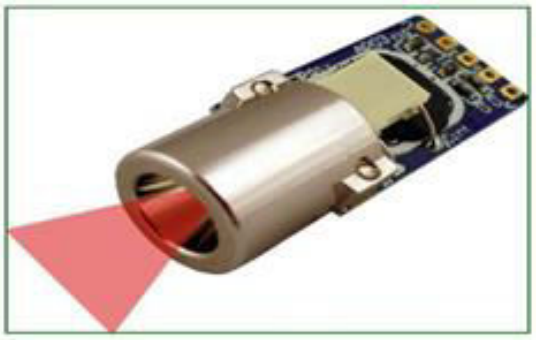

Figure.1.3.IR Sensor

GAS SENSOR

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in firefighting. Some strata gases that get mixed with underground mine atmosphere are highly poisonous and a few are dangerously flammable. Various gases are also formed in underground mines due to chemical reactions, such as spontaneous heating of coal, etc. Concentration of mine gases found at any time and location may vary due to different factors like diffusion, turbulent dispersion, and leakage in subsurface ventilation systems. Therefore, it is necessary to deploy sensors to monitor and measure toxic and flammable gas concentration levels in subsurface atmosphere for the safety of underground miners as well as mines. Each sensor has its own advantages and limitations. Some sensors are better for sensing toxic gases.

Figure.1.4 Gas Sensor

VIBRATION SENSOR

Chaos sometimes begins with a low rumble or a small shake. If a sensor is involved, it might be measuring the first vibrational movements of an earthquake or a mechanical failure in an industrial setting. As machines or the electronics and components within machines begin to move back and forth, the vibration is preventing a smooth flow of energy. The flow is interrupted, hence the noise and the shake. Typically it's overload due to some sort of stress, or the components themselves may have reached their useful life—gears, teeth, bearings, or belts may be in the process of failure. Vibrations produced by industrial machinery are vital indicators of machinery health. Vibration analysis is used as a tool to determine a machine's condition and the specific cause and location of problems, expediting repairs and minimizing costs. Machinery monitoring programs record a machine's vibration history.

Figure.1.5.Vibration Sensor

LIQUID CRYSTAL DISPLAY

Liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. The surface of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is unidirectionally rubbed using, for example, a cloth. The direction of the liquid crystal alignment is then defined by the direction of rubbing.

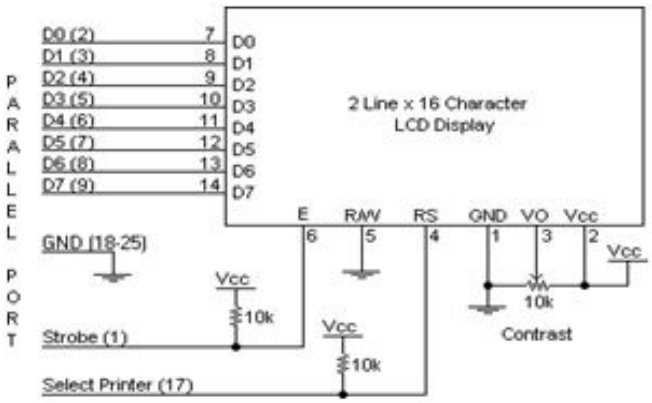

Figure.1.6.LCD

Figure.1.7.Receiver

INTERNET OF THINGS

The IoT represents the convergence of a variety of computing and connectivity trends that have been evolving for many decades. At present, a wide range of industry sectors including automotive, healthcare, manufacturing, home and consumer electronics, and well beyond are considering the potential for incorporating IoT technology into their products, services, and operations. Having an IoT system in place also significantly reduces the downtime of broken machinery. Companies are able to lower the risk of equipment breaking in the middle of a project or shift and they are also able to preemptively order parts that will be needed to restore broken machines as soon as possible. The technology behind the Internet of Things has been a long time in the making, even starting before we had computers. Machine-to-Machine (M2M) communication has been a thing for quite some time that transmitted encoded readings from measuring instrumentation over phone lines, radio waves or satellite communications. Telemetry has since been used for things like monitoring weather and tracking wildlife, and it's even used to monitor the occupants and equipment on the International Space Station (ISS).It's more unusual not to be connected to the Internet. The web grew, high-speed Internet entered the home and wireless networking became ubiquitous. And all that time, microchips and other computing equipment were getting smaller and smaller until we finally started putting them in mobile devices. Our smartphones of today can hop on the net via cellular or WiFi signals and talk to other devices

CLOUD

Cloud storage works through data center virtualization, providing end users and applications with a virtual storage architecture that is scalable according to application requirements. In general, cloud storage operates through a web-based API that is remotely implemented through its interaction with the client application's in-house cloud storage infrastructure for input/output (I/O) and read/write (R/W) operations. When delivered through a public service provider, cloud storage is known as utility storage .Cloud storage is a rich resource for both hackers and national security agencies. Because the cloud holds data from many different users and organizations, hackers see it as a very valuable target. Here after PC will help us to monitoring the removing of helmet while workers in minningarea and leakage of toxic gas and vibration will any collision occurred.

FUTURE DEVELOPMENT

A few aspects of the system can be improved such Node hopping can be implemented to allow transmissions to the supervisor or even a central control station. This can be done by adding stationary nodes that are programmed to only bounce any signal that is received. A transceiver unit could be integrated in both the helmet and the central unit PC so that the central unit and the helmet unit can have two way communications in case the central unit wants to send commands the miners. The system can be improved by adding more measuring devices to check the miner’s blood pressure and heart rate. In future, modules can also be used for secondary services, such as localization of workers relative to each other.

III.CONCLUSIONS

A smart mining helmet was developed that is capable of detecting three types of hazardous events such as presence of hazardous gases, miner helmet removing, and collision or impact (miners are struck by an object). The hazardous events were classified as a miner removing the mining helmet off their head. An off-the-shelf IR sensor was then used to successfully determine when the helmet is on the miner’s head. Another hazardous event is defined as an event where miners are struck by an object against the head. A vibration sensor was used and calibrated to detect the collision to the head of the miner. It was observed that the vibration sensor should be placed on the inside of the helmet.

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