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LeMenizInfotech

36, 100 Feet Road, Natesan Nagar, Near Indira Gandhi Statue,
Pondicherry-605 005.

Call: 0413-4205444, +91 9566355386, 99625 88976.

Web : www.lemenizinfotech.com/ www.ieeemaster.com

Mail : projects@lemenizinfotech.com

A Smart Helmet for Air Quality and Hazardous Event Detection for the Mining Industry

Abstract:

A smart helmet has been developed that is able to detect of hazardous events in the mines industry. In the development of helmet, we have considered the three main types of hazard such as air quality, helmet removal, and collision (miners are struck by an object). The first is the concentration level of the hazardous gases such as CO, SO₂, NO₂, and particulate matter. The second hazardous event was classified as a miner removing the mining helmet off their head. An IR sensor was developed unsuccessfully but an off-the shelf IR sensor was then used to successfully determine when the helmet is on the miner's head. The third hazardous event is defined as an event where miners are struck by an object against the head with a force exceeding a value of 1000 on the HIC (Head Injury Criteria). An accelerometer was used to measure the acceleration of the head and the HIC was calculated in software.

Existing system:

Presently mining safety helmets only have the purpose of protecting the miner's head against potential hazardous bumps. The safety helmets do not have any technology added to it to let miners know when a fellow miner has encountered a

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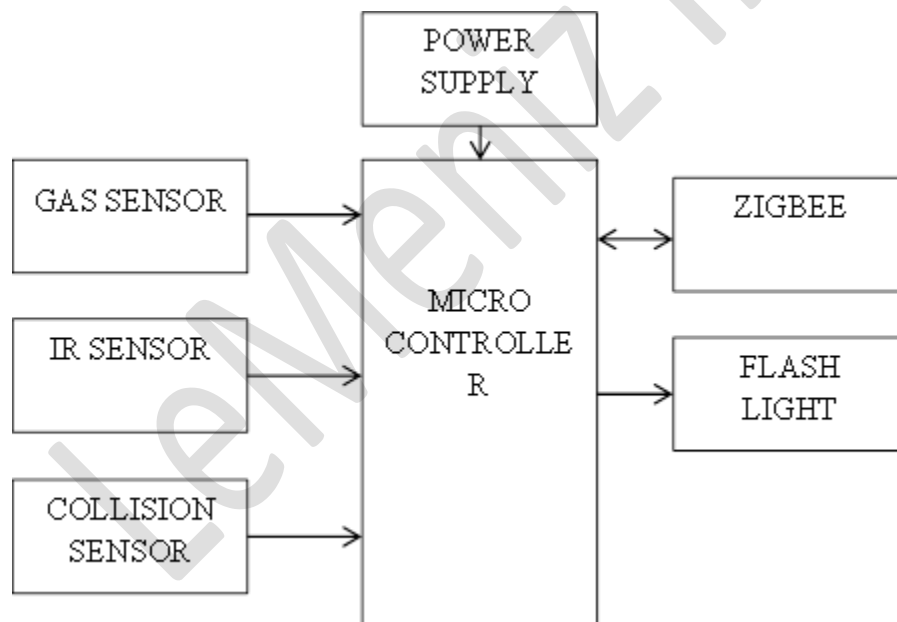
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hazardous event. In recent years, harvesting technology has played an important role in the area of mine applications. The literature on mines technology is available but very limited.

Disadvantage:

- As a result, the existing proposals very few have been implemented and tested in the real-world, identifying the existence of a gap between theory and real world application at scientifically accepted level.

Block Diagram:





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Proposed system:

In order to explain the entire system, the system is divided into six units. Helmet remove sensor, which is used to detect the miner, is wearing the safety helmet or not this is achieved through the IR sensors. Collision sensor, which is used to detect and identify whether any objects fall over the miner and this is achieved through accelerometer. Air quality sensor, which is used to detect Air pollution from coal mines. It is mainly due to emissions of particulate matter and gases include methane (CH₄) and carbon monoxide (CO). Data processing unit the micro controller which is used to get all the data from the above all sensor and concludes whether need any intimation to wireless unit or the user wearing it. Wireless transmission and alerting unit is used to transfer the data obtained from the processing unit. It is achieved through Zigbee.

Advantages:

- The transmission was successful at distances more than double than were specified.
- The critical levels of the hazardous gases such as CO, CH₄ in the mines industry has been indicated through alerting unit.
- The system successfully detected when the helmet is removed 10 cm off the dummy head with an average deviation of 0.3% too far.

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Conclusion:

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. The hazardous events were classified as a miner removing the mining helmet off their head. Another hazardous event is defined as an event where miners are struck by an object against the head with a force exceeding a value of 1000 on the HIC (Head Injury Criteria). The system can be improved by adding more measuring devices to check the miner's blood pressure and heart rate. Gas concentrations can be measured as well. In future, it could also be considered if such modules can also be used for secondary services, such as localization of workers relative to each other.

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