

Lightweight Mash up Middleware for Coal Mine Safety Monitoring and Control Automation

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Abstract: The Mine Safety Monitoring System Plays A Major Concern In Almost All The Countries As It Requires Large Amount Of Explosive Gases And Chemicals For Its Operation. The Life Of Miners In Underground Environment Is Of Major Concern In Considering The Safety Measures In Mine Sectors. In Coal Mines, Whenever Explosions Or Any Gas Leakage Occur, The Mine Workers Are Not Aware Of The Environmental Condition Inside Coal Mine Because The Wired Mine Monitoring Systems May Be Destroyed Or Damaged. This Makes The Life Of Workers Very Risky. It Also Takes Some Time For The Rescue Workers To Reach The Spot. This Project Addresses An Economical And Continuous Monitoring System Of Underground Mine Workers' Protection And Security. Gas Sensors Are Used For Monitoring Underground Parameters Using Wsn (Wireless Sensor Network). A Microcontroller Based System Is Used For Collecting And Storing Data And Making Decision Accordingly, Based On Which The Mine Worker Is Informed Through The Alert System. The Communication System Is Reliable Based On Zigbee Ieee 802.15.4 Standard. This Is Used For Wireless Transmission Between The Hardware Circuit Fitted With The Mine Station And The Ground Control Computer System Through Some Routers.

I. Existing System:

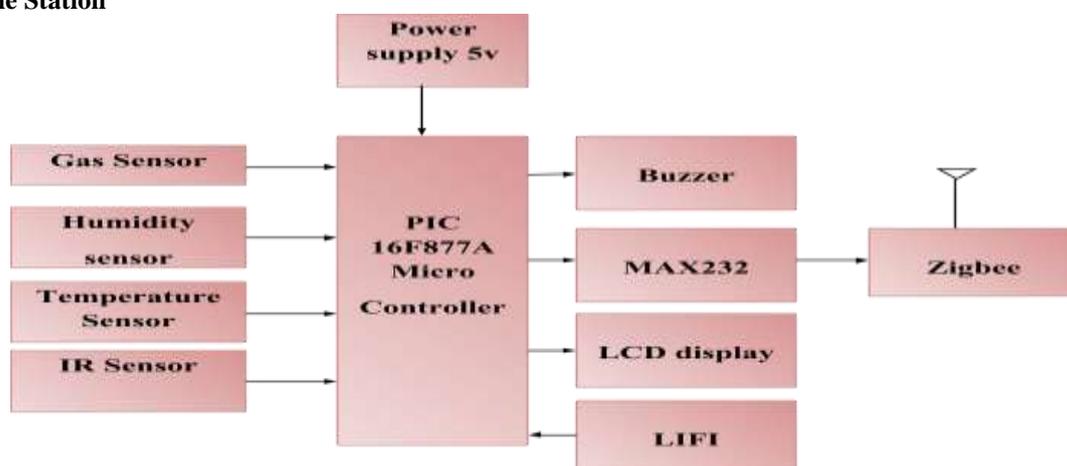
- In The Existing Method The Atmospheric Conditions Inside The Coal Mines Are Monitored Manually Or By Using Sensors But The Sensed Data Cannot Be Sent To The Control Room Every Time.
- Also The Alert Intimation Will Be Sent Manually To The Miners Which Are Time Consuming And Within This Period Of Time The People Inside The Mine Will Be Affected. Due This Method There Is No Safety To The People To Move Inside The Mines.

II. Proposed System:

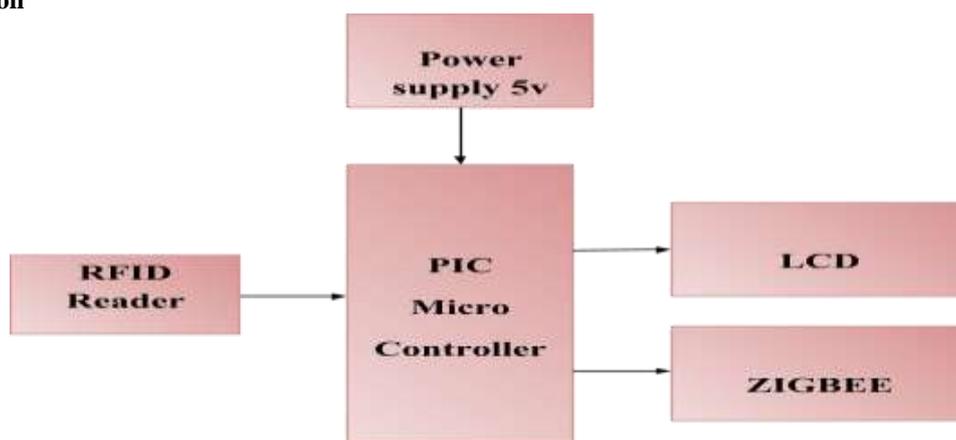
The Proposed System Consists Of Three Module Namely Mobile Station, Base Station And Master Node. In The Proposed Method We Are Using Zigbee As A Wireless Technology Which Is Used To Send The Sensed Data To The Base Station Node And. The Values From Base Station Will Be Sent Using Zigbee To The Control Server. The Mobile Station Isbelow ,

Block Diagram

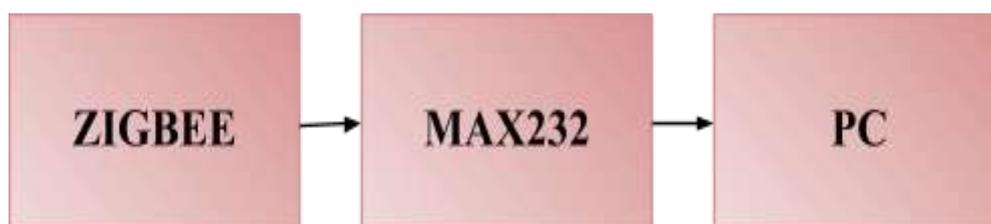
Mobile Station



Base Station



Server Section



Hardware Requirement:

1. Pic16f877a Microcontroller
2. Lcd Display
3. Gas Sensor
4. Temperature Sensor
5. Humidity Sensor
6. Rfid Tag & Reader
7. Zigbee Transceiver
8. 5v Power Supply
9. Pc
10. Buzzer

Software Requirement:

1. Mplab(Microcontroller Programming)
2. Pickit2(Programmer)
3. Embedded C Program
4. Proteus Circuit Designer

Software Program Testing

The Software Program Is Written In Embedded 'C' Language And Compiled By Hi-Tech C Compiler Using Mplab Ide Software. The Compiler Is Used To Convert Middle Level Language Into Machine Level Language. After Compiler Operation The Hex Code Is Generated And Stored In The Computer. The Hex Is Nothing But Machine Level Language Understands By The Micro Controller. The Hex Code Of The Program Is Burnt Into The Rom (Flash Memory) Of Pic16f877a By Using Pickit2 Programmer

III. Hardware Description

Pic16f877a:

It Is High Performance Risc Cpu Machine. Only Have 35 Simple Word Instructions. Operating Speed: Clock Input (200mhz), Instruction Cycle (200ns).Up To 368×8bit Of Ram (Data Memory), 256×8 Of Eeprom (Data Memory), 8k×14 Of Flash Memory. Wide Operating Voltage Range (2.0 – 5.56) Volts.2 8 Bit Timer And One 16 Bit Timer Is Available 10bit Multi-Channel A/D Converter Synchronous Serial Port (Ssp) With Spi

(Master Code) And I2c (Master/Slave). 100000 Times Erase/Write Cycle Enhanced Memory.1000000 Times Erase/Write Cycle Data Eeprom Memory.

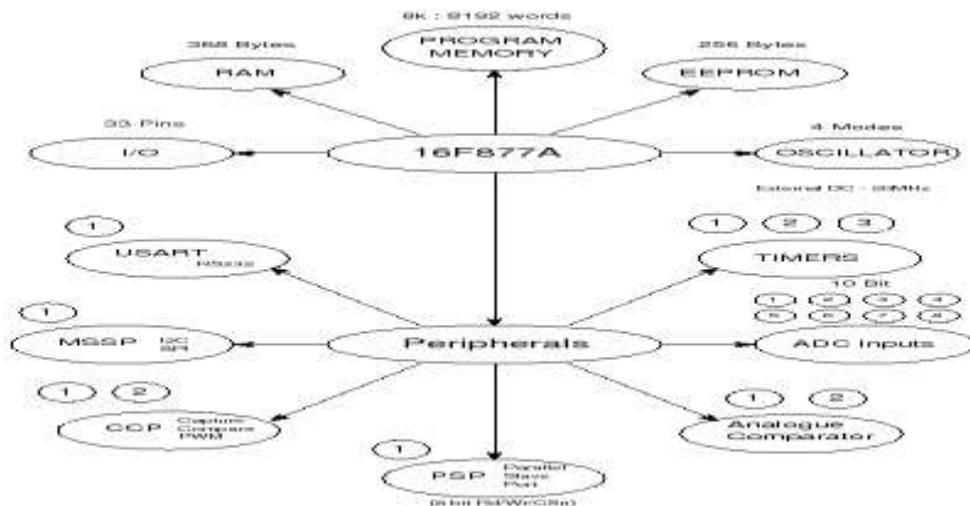
- **Power Supply Circuit**

The Hardware Of Project Requires Different Power Supplies. 5 V. The Interfacing Devices Will Get The Supply From Main Microcontroller

- **Lcd:**

Lcd (Liquid Crystal Display) Screen Is An Electronic Display Module And

Find A Wide Range Of Applications. A 16x2 Lcd Display Is Very Basic Module And Is Very Commonly Used In Various Devices And Circuits. A 16x2 Lcd Means It Can Display 16 Characters Per Line And There Are 2 Such Lines. In This Lcd Each Character Is Displayed In 5x7 Pixel Matrix. This Lcd Has Two Registers, Namely, Command And Data.



- **Max232**

Max232 Is Used To Convert Ttl Into Rs232 Logic Level Converter Used Between The Microcontroller And The Gsm Board Or Pc .Our Controller Is Operated At 5v But Interfacing Devices Are Worked With 12 V .So This Ic Will Convert The Level Of 5v To 12 V For Transmitting . While Receiving Convert 12v Into 5v To The Microcontroller.

- **Rfid**

"Rfid" Stands For Radio Frequency Identification. The Tag's Antenna Picks Up Signals From An Rfid Reader Or Scanner And Then Returns The Signal, Usually With Some Additional Data (Like A Unique Serial Number Or Other Customized Information). Rfid System Consists Of Three Components: An Antenna Or Coil, A Transceiver (With Decoder) And A Transponder (Rf Tag) Electronically Programmed With Unique Information. An Rfid Reader Is A Device That Is Used To Interrogate An Rfid Tag. The Reader Has An Antenna That Emits Radio Waves; The Tag Responds By Sending Back Its Data.

- **Lifi**

Li-Fi Technology Proposed And Provides Transmission Of Data Through Illumination By Sending Data Through An Led Light Bulb That Varies In Intensity Faster Than The Human Eye Can Follow. Li-Fi Provides Better Bandwidth, Efficiency, Availability And Security Than Wi-Fi And Has Already Achieved Blisteringly High Speed In The Lab.

- **Zigbee**

Zigbee Is A Wireless Technology Developed As An Open Global Standard To Address The Unique Needs Of Low-Cost, Low-Power Wireless M2m Networks. The Zigbee Standard Operates On The Ieee 802.15.4 Physical Radio Specification And Operates In Unlicensed Bands Including 2.4 Ghz, 900 Mhz And 868 Mhz . The Zigbee Protocol Was Designed To Provide An Easy-To-Use Wireless Data Solution Characterized By Secure, Reliable Wireless Network Architectures. Support For Multiple Network Topologies Such As Point-To-Point, Point-To-Multipoint And Mesh Networks .

Low Duty Cycle – Provides Long Battery Life
Low Latency
Direct Sequence Spread Spectrum (Dsss)
Up To 65,000 Nodes Per Network
128-Bit Aes Encryption For Secure Data Connections
Collision Avoidance, Retries And Acknowledgements

Buzzer

A Buzzer Or Beeper Is An Audio Signaling Device, Which May Be Mechanical, Electromechanical, Or Piezoelectric. A Buzzer Or Beeper Is A Signaling Device, Usually Electronic, Typically Used In Automobiles, Household Appliances Such As A Microwave Oven, Or Game Shows.

IV. Temperature Sensor

The Lm35 Series Are Precision Integrated-Circuit Temperature Sensors, Whose Output Voltage Is Linearly Proportional To The Celsius (Centigrade) Temperature. . The Lm35 Is Rated To Operate Over A -55° To $+150^{\circ}\text{C}$ Temperature Range. A Digital Thermometer Can Be Easily Created By Using Lm35 Temperature Sensor And Can Be Interfaced Any Microcontrollers.

V. Gas Sensor

The Sensors Contain Two Or Three Electrodes, Occasionally Four, In Contact With An Electrolyte. The Electrodes Are Typically Fabricated By Fixing A High Surface Area Precious Metal On To The Porous Hydrophobic Membrane. The Working Electrode Contacts Both The Electrolyte And The Ambient Air To Be Monitored Usually Via A Porous Membrane. The Electrolyte Most Commonly Used Is A Mineral Acid, But Organic Electrolytes Are Also Used For Some Sensors. The Electrodes And Housing Are Usually In A Plastic Housing Which Contains A Gas Entry Hole For The Gas And Electrical Contacts.

VI. Humidity Sensor

Humidity Is Defined As The Water Vapour Content In Air Or Other Gases. Humidity Is Usually Measured In Terms Of Absolute Humidity (The Ratio Of The Mass Of Water Vapour To The Volume Of Air Or Gas), Dew Point (The Temperature And Pressure At Which A Gas Begins To Condense Into A Liquid), And Relative Humidity, Or Rh (The Ratio Of The Moisture Content Of Air Compared To The Saturated Moisture Level At The Same Temperature Or Pressure).

VII. Ir Sensor

The Ir Sensor Is A Very Simple Device That Works By Reflecting Infrared Light Off Of An Object And Detecting The Reflecting With A Photo-Transistor That Is Tuned To The Same Frequency Of Light. The Led Is Mounted Next To The Photo-Transistor; However, The Emitted Light From The Led Does Not Directly Shine Into The Photo-Transistor. Appropriate Values For Resistance Are In Series With Both The Led To Limit Current And The Photo-Transistor In Order To Show A Voltage Drop Based On Distance To The Object In Front Of The Sensor. The Effective Range Of The Sensor Is A Few Centimeters. Object Detection Can Be Enhanced By Placing A Reflective Surface Between The Object And The Sensor. When The Object Passes Between The Sensor And Reflective Surface, A Large Drop Will Be Observed In The Output Signal.

VIII. Conclusions:

In This Paper, The Implementation Of Integrated Mine Safety Monitor System Is Explained. The System Is Composed Of Pc Monitors, Sink Nodes, Base Station Nodes And Mobile Nodes. This Mine Safety Monitoring System Based On Wireless Sensor Networks, And Hardware And Software Design Of Wireless Sensor Network Are Described In Detail, This System Can Detect Concentration Of The Gas, Temperature, Humidity, Wind Speed And Trace The Location Of Miners In Underground Mine Tunnels. Wireless Sensor Networks Applied In Monitoring Coalmine Security Breaks Through The Traditional Methods And Ideas, Which Improves The Practical Ability And Flexibility Of Monitoring System. This System Not Only Can Monitor All Kinds Of Parameters Under The Coal Mine, But Also Can Alarm Automatically When Environment Parameters Are Abnormal To Exceed The Limitation, Which Help Improve The Level Of Monitoring Safety Production And Reduce Accident In The Coal Mine. Traditional Mine Security System Can Be Effectively Replaced By The Surveillance And Safety System Proposed In The Paper. This System Is An Open System, And It Allows Developing Other Applications On It. It Provides Much Spatial Gas Concentration Data With The Timestamp For Follow-Up Gas Prediction On It.

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