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Web of Things Based Monitoring System for Coal Mine Safety by Using Raspberry Pi Processor

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Abstract:
Aiming at the weakness and deficiency of current coal mine monitoring system, this paper discusses the design and implementation of a platform to remotely monitor and control coal mine production processes over Industrial Ethernet by using the embedded technology. Integrated with each lower computer terminal are Raspberry Pi microprocessors that can be used for connectivity to the monitoring network effectively. Besides the terminal core Raspberry Pi, the hardware circuits of memory module, input and output channels, Additionally, Linux-based application software that facilitates remote monitoring and control of lower computer terminals using Qt/embedded has also been developed. The monitoring system presented in this paper can not only meet the requirements of coal mine production process, but also has a wide range of applications in other industrial monitoring fields.

Keywords:
LED's, multi sensors, Raspberry Pi processor, AT89S52 controller.

I. INTRODUCTION:

India is a large country with rich coals. However, the current safe production level of coal mine is still low, especially in recent years, disasters in coal mine occur frequently, which lead to great loss of possession and life.

The safety problems of coal mine has gradually become to the focus that the nation and society concern on. The disasters happening in coal mine are due to the complexity of mine environment and the variety of work condition of coal mine, so it is very necessary to monitor mine working environment. Traditional coal mine monitoring systems tend to be wired network systems, which play an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become blind areas, where in there are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we will design a coal mine safety monitoring system based on wireless sensor network, which can improve the level of monitoring production safety and reduce accident in the coal mines Wireless sensor networks is composed of a large number of micro-sensor nodes which have small volume and low cost. It possesses self-organized capability by wireless Communication. In recent years, it is widely used in the fields of our lives, scientific research, military, intelligent traffic, environmental monitoring, intelligent weapon, and so on. Compared to the traditional mine monitoring, we use wireless sensor networks in coal mine safety monitoring. It has three significant advantages: (1) It is unnecessary to lay cables, and can be installed in monitoring blind areas to reduce the costs of extending the system. More number of nodes can be arranged to eliminate blind areas.

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Wireless sensor nodes can make general communication and allocate the goal; (2) The nodes are dense, which can ensure data acquisition high accuracy and efficiency of data transmission, and realize the real-time monitoring of coal mine working environment; (3) Sensor nodes with a certain computing ability, storage capacity, data fusion are ideal for remote monitoring. Therefore we can make use of the wireless sensor network to monitor Production safety of coal mine.

II. RELATED WORK:

2.1 BLOCK DIAGRAM:

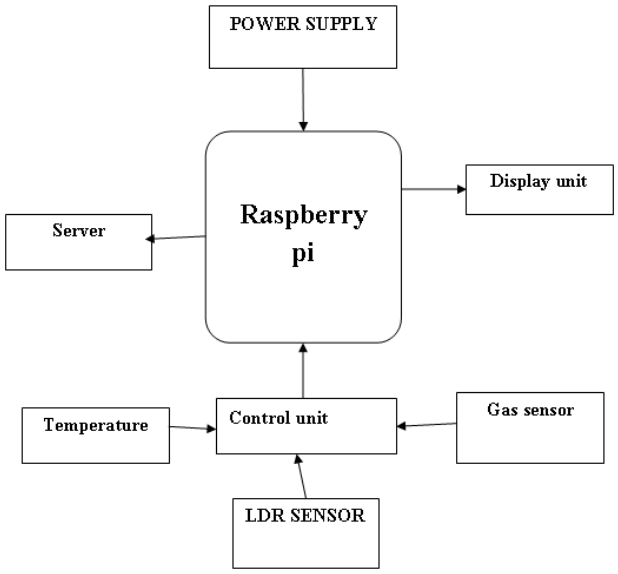

Figure-1: Block diagram of project

2.2 RASPBERRY PI PROCESSOR:

The Raspberry Pi board contains a processor and graphics chip, program memory (RAM) and various interfaces and connectors for external devices. Some of these devices are essential, others are optional. It operates in the same way as a standard PC, requiring a keyboard for command entry, a display unit and a power supply. The Raspberry Pi board is a miniature marvel, packing considerable computing power into a footprint no larger than accredit card. It's capable of some amazing things, but there are a few things you're going to need to know before you plunge head-first into the bramble patch.

2.3 AT89S52 MICROCONTROLLER:

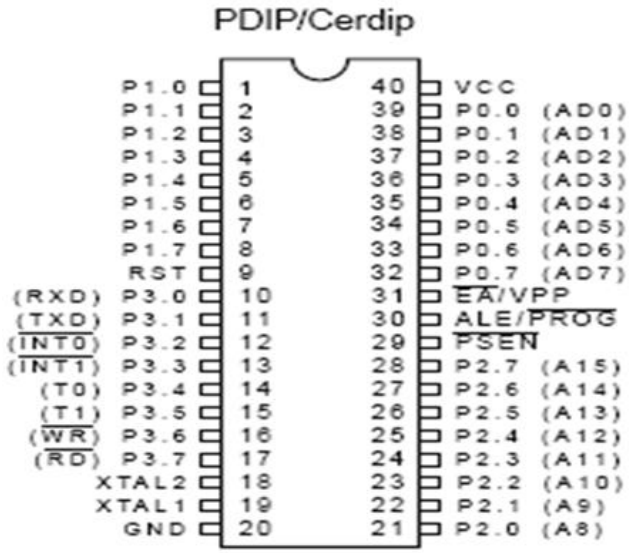

Figure-2: AT89S52 microcontroller

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 con-tents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset. The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile 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 nonvolatile memory pro-grammer.

2.4. EXISTING METHOD:

In the existing system the intelligent monitoring system is design to store the data in small microcontroller system and for watching that data we need to connect that small microcontroller system to Computer System. The data presented on the computer is not in presentable format.

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2.5. PROPOSED METHOD:

Our embedded project is designed to overcome the drawbacks present in existing method. It focuses on the difficult points of developing the GUI applications based on Qt/Embedded and the Linux drivers for various types of sensors in the Intelligent Monitoring System project, achieving the combination of Qt/Embedded and the Linux system programming. Our proposed project eliminates the need of separate computer system connected to microcontroller board. Our Proposed project is the sensor board plus a full flag computer system. The sensors like Gas sensor, LDR, Temperature sensors are connected to ARM11 controlling board. The sensor values we are monitoring on the ARM11 board or on any computer using easily available on monitor.

III. SENSORS:

3.1 LIGHT DEPENDENT RESISTOR:

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1,000,000 ohms, but when they are illuminated with light, the resistance drops dramatically. Thus in this project, LDR plays an important role in controlling the electrical appliances based on the intensity of light i.e., if the intensity of light is more (during daytime) the loads will be in off condition. And if the intensity of light is less (during nights), the loads will be switch ON. LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically.

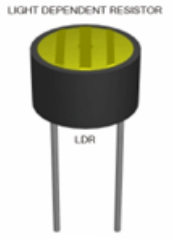

Figure-3: LDR sensor

3.2. TEMPERATURE SENSOR:

In this project, in order to monitor the temperature continuously and compare this with the set temperature preprogrammed in the microcontroller, initially this temperature value has to be read and fed to the microcontroller. This temperature value has to be sensed. Thus a sensor has to be used and the sensor used in this project is LM35. It converts temperature value into electrical signals. LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.

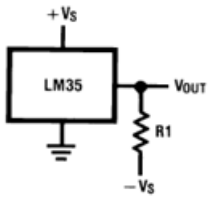

Figure-4: LM35 sensor

3.4 GAS SENSOR:

Figure-5: Gas Sensor

MQ2 flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage.

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The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V. Connecting 5v across the heating (H) pins keeps the sensor hot enough to function correctly. Connecting five volts at either the A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. Both configurations have the same pin out consistent with the bottom configuration. The resistive load should be calibrated for your particular application using the equations in the datasheet, but a good starting value for the resistor is 20 kΩ.

IV. RESULTS:

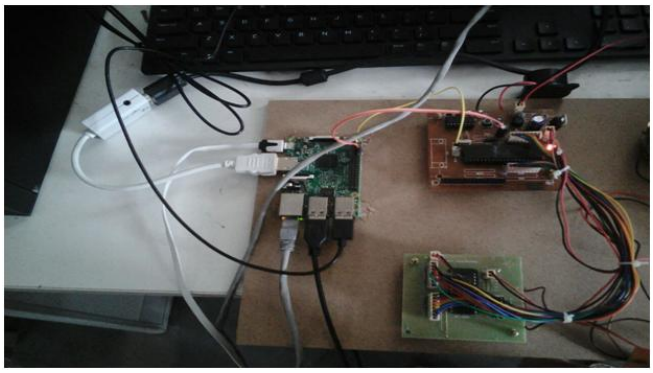

Figure-6: Interfacing of sensors

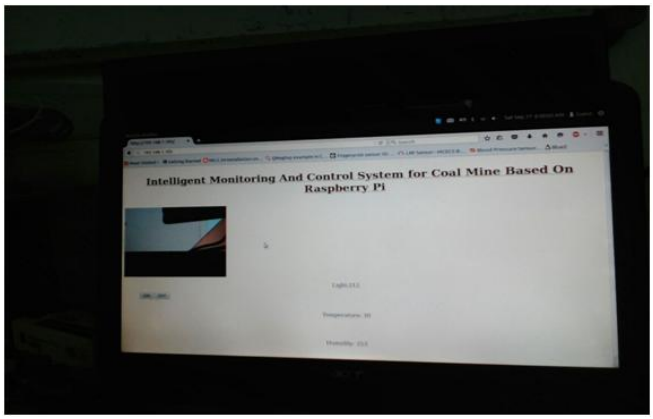

Figure-7: Output of project

V. CONCLUSION:

This article offers a fundamental study on the design and implementation of the remote network monitoring system of coal mine.

In this work, we discussed the design and research of hardware architecture and software platform based on Raspberry Pi microprocessor. The embedded microprocessor provides the needed flexibility and scalability in lower computer terminals design. The embedded solution scheme and technology makes the hardware circuits easy to realize in practice, and ensures the monitoring system has higher viability in harsh environment. The proposed architecture and results demonstrate the feasibility of using Industrial Ethernet to communicate effectively with lower computer terminals with respect to both functions, of monitoring and control. It can adapt to the complex production environment in underground coal mine.

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