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Design and Implementation of Industrial Monitoring System through Wireless Sensor Networks

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ABSTRACT:
This paper proposes an advanced system for process management via a credit card sized single board computer called raspberry pi based multi parameter monitoring hardware system designed using RS232 and microcontroller that measures and controls various global parameters. The system comprises of a single master and multiple slaves with wireless mode of communication and a raspberry pi system that can either operate on windows or linux operating system. The parameters that can be tracked are temperature, light intensity and gas sensor. The hardware design is done with the surface mount devices (SMD) on a double layer printed circuit board (PCB) to reduced the size and improve the power efficiency. The various interesting features are field device communication via USB-OTG enabled Android devices, on field firm ware update without any specific hardware and remote monitoring and control.

Keywords:
Raspberry Pi processor, AT89S52 controller, Zigbee module, gas sensor, temperature sensor, LDR sensor.

I.INTRODUCTION:
The entire system is designed with the double layer SMD based embedded board with different sensors and a raspberry pi that can compile and communicate the data received from the sensors. The raspberry pi when operated on the Linux operating system can perform multi-tasking [20]. The design of the embed board includes the interfacing of different sensors to two slave boars and connecting those slave to a master board through RF transmission.

The master and slave boards use PIC 18F4550 Microcontroller, Encoder and Decoder ICs (HD12E & HD12D), LM35 & LDR Sensors, Water level sensor(IC CD4066) and RF Transceivers. The RF transceivers present in slave and master boards uses the process of serial communication and as most of the computers have more than one serial port there is no need of any special hardware other than a cable. The effective baud rate is the main advantage of using RS232 and also the transmission is on both directions which mean the inverted logic is also handled with the same. RS232 uses MARK (negative voltage) and SPACE (positive voltage) as two voltage states. So the baud rate is identical to the maximum number of bits transmitted per second including the control bits. The transmission rate of this device is 9600 baud with the duration of start bit and each subsequent bit is about 0.104ms. The complete character frame of 11 bits is transmitted in 1.146ms. MAX 232 IC mounted on the master board converts the 0's and 1's to TTL logic.

II. RELATED WORK:
2.1 TRANSMITTER:

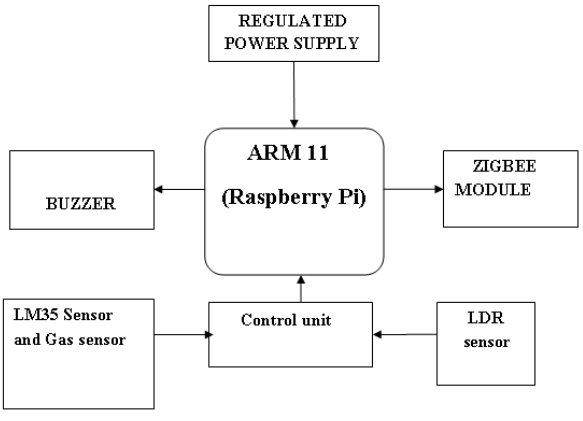

Figure-1: Block diagram of transmitter

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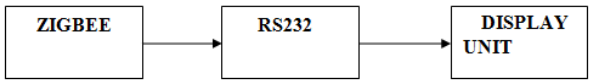

Figure-2: Block Diagram of receiver

2.2 EXISTING METHOD:

THE SMART GRID is an intelligent monitoring system, distribution, and control system. The proposed system is helpful in collection and analysis of real time data. emphasizing the importance of the communication infrastructures required to support data exchange between the various domains which comprises the smart grid. Our proposed scheme is implemented with a ZIGBEE protocol.

2.3 PROPOSED METHOD:

In proposed system we extend our data transmission to ZIGBEE so that the relevant parameters are monitored controlling through ZIGBEE. This is very useful in the case when the user is moving in industrial area. Along with the data monitoring devices is also controlled based on the values.

III. HARDWARE COMPONENTS:

3.1 RASPBERRY PI PROCESSOR:

Figure-3: Raspberry Pi diagram

The Raspberry Pi board involves a processor and snap shots chip, Random Access Memory (RAM) and more than a few interfaces and connectors for external devices. Some of these instruments are main others are optional. It operates in the identical method as a ordinary pc, requiring a keyboard for command entry, a show unit and a vigor give. considering that raspberry Pi board operates like pc it requires 'mass-storage', but a tough disk pressure of the variety observed in a ordinary pc is not relatively in maintaining with the miniature dimension of Raspberry Pi.

3.2 TEMPERATURE SENSOR (LM35):

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.

3.3 GAS SENSOR:

Figure-4: Gas Sensor

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

3.4. ZIGBEE MODULE:

ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. The ZigBee Alliance, the standards body that defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products.

3.5 LIGHT DEPENDENT RESISTOR:

LD`Rs 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. LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits.

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Figure-5: LDR sensor

IV. RESULTS:

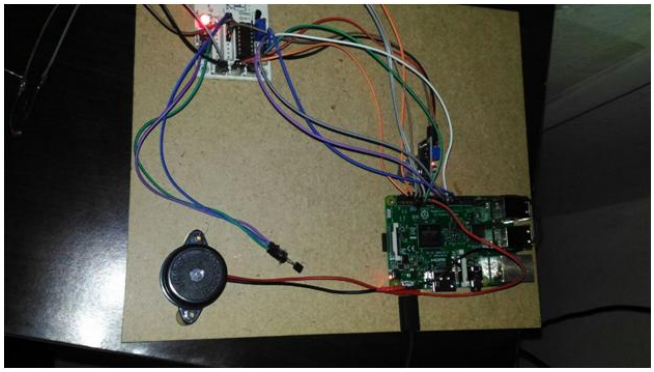

Figure-6: Hardware of the project

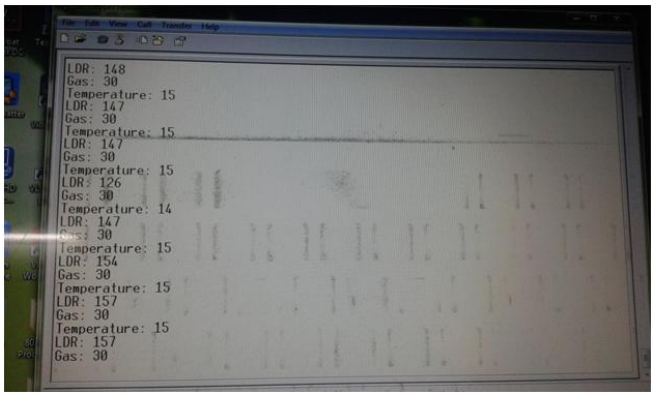

Figure-6: Output on hyperterminal

V. CONCLUSION:

The project "DESIGN AND IMPLEMENTATION OF INDUSTRIAL MONITORING SYSTEM THROUGH WIRELESS SENSOR NETWORKS" has been successfully designed and tested.

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It has been developed by integrating features of all the hardware components and software used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced ARM11 board and with the help of growing technology the project has been successfully implemented.

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