

WSN in IOT Environment Interfacing with Smart Sensors Using Arm7 with Zigbee for Industries

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Abstract: A sensor interface device is essential for sensor data collection of industrial wireless sensor networks (WSN) in IoT environments. The Internet of Things (IoT) environment, each sensor connected to the device is required to write complicated and cumbersome data collection program code. In the proposed method we overcome the drawback present in existing system by using wireless sensor network. We are designed a system by using ARM 32-bit micro controller which supports different features and algorithms for the development of industrial automation systems. Using ARM controller we can connect all types of sensors and we can connect 8 bit microcontroller based sensor network to ARM controller using different wireless technology called Zigbee. Many open source libraries and tools are available for ARM-Linux wireless sensor network development and controlling. We can monitor and control the wireless sensor network remotely using internet and web server.

Keywords: ZigBee, Internet of Things (IOT), ARM7, Temperature, Gas, Light Sensors, sensor data acquisition.

I. INTRODUCTION

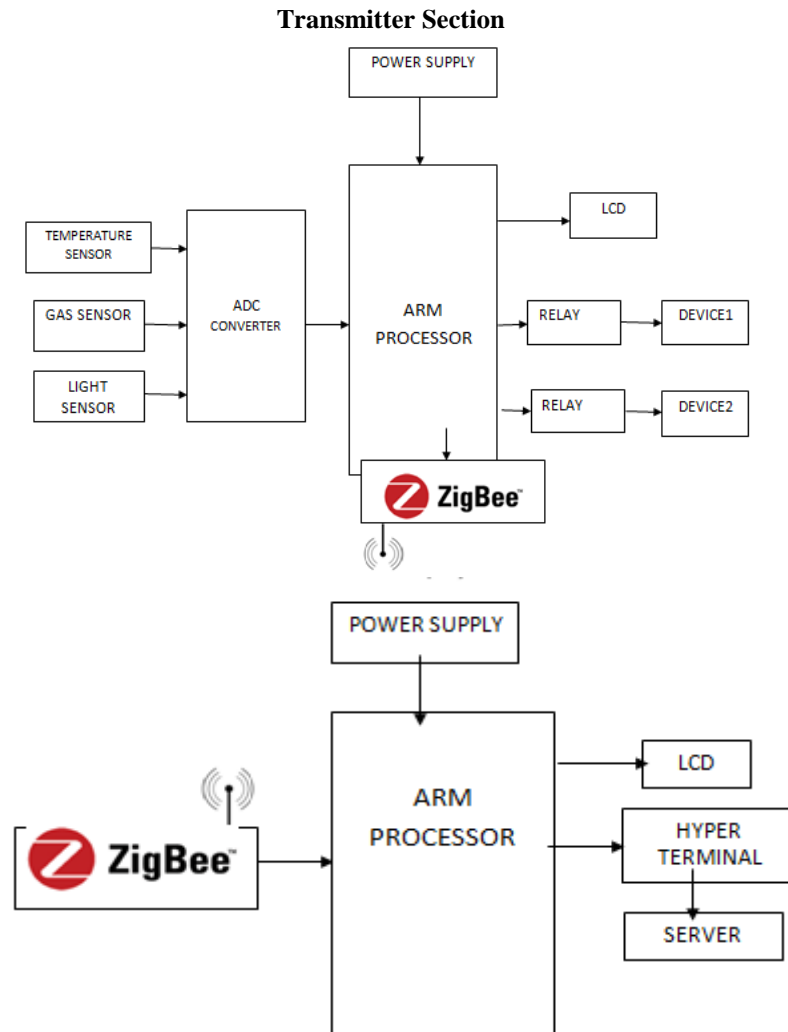
Wireless Sensor Networks (Wsn) has been employed to collect data about physical phenomena in various applications such as habitat monitoring, and ocean monitoring, and surveillance. As an emerging technology brought about rapid advances in modern wireless telecommunication, Internet of Things (IoT) has attracted a lot of attention and is expected to bring benefits to numerous application areas including industrial WSN systems, and healthcare systems manufacturing. WSN systems are well-suited for long-term industrial environmental data acquisition for IoT representation. Sensor interface device is essential for detecting various kinds of sensor data of industrial WSN in IoT environments. It enables us to acquire sensor data. Thus, we can better understand the outside environment information. However, in order to meet the requirements of long-term industrial environmental data acquisition in the IoT, the acquisition interface device can collect multiple sensor data at the same time, so that more accurate and diverse data information can be collected from industrial WSN. With rapid development of IoT, major manufacturers are dedicated to the research of multi sensor acquisition interface equipment.

There are a lot of data acquisitions multiple interface equipments with mature technologies on the market. But these interface devices are very specialized in working style, so they are not individually adaptable to the changing IoT environment. Meanwhile, these universal data acquisition interfaces are often restricted in physical properties of sensors (the connect number, sampling rate, and signal types). Now, micro control unit (MCU) is used as the core controller in mainstream data acquisition interface device. MCU has the advantage of low price and low power consumption, which makes it relatively easy to implement. But, it performs a task by way of interrupt, which makes these multi sensor acquisition interfaces not really parallel in collecting multi sensor data. On the other hand, FPGA/CPLD has unique hardware logic control, real-time performance, and synchronicity, which enable it to achieve parallel acquisition of multi sensor data and greatly improve real-time performance of the system. FPGA/CPLD has currently becomes more popular than MCU in multi sensor data acquisition in IoT environment.

However, in IoT environment, different industrial WSNs involve a lot of complex and diverse sensors. At the same time, each sensor has its own requirements for readout and different users have their own applications that require different types of sensors. It leads to the necessity of writing complex and cumbersome sensor driver code and data collection procedures for every sensor newly connected to interface device, which brings many challenges to the researches.

II. RESULTS AND DISCUSSIONS

Block Diagram:



II. HARDWARE REQUIREMENT

A. Temperature Sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C)

The LM35 - An Integrated Circuit Temperature Sensor

- You can measure temperature more accurately than a using a thermistor.
- The sensor circuitry is sealed and not subject to oxidation, etc.
- The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

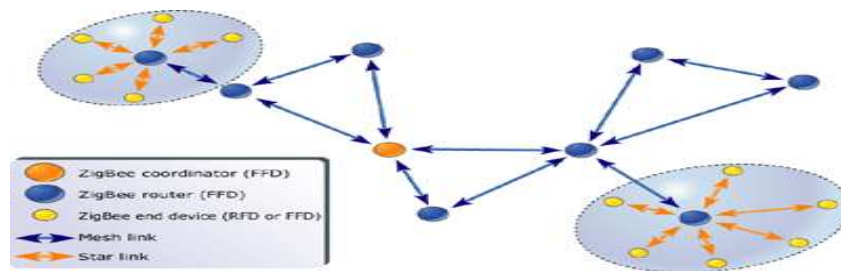


B. Zigbee Module

ZigBee is the name of a specification for a suite of high level communication protocols using small, low-power, low data rate digital radios based on the IEEE 802.15.4 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology is intended to be simpler and cheaper than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications which require a low data rate, long battery life, and secure networking.

Features of 802.15.4

- Data rates of 250 kbps with 10-100 meter range.
- Two addressing modes; 16-bit short and 64-bit IEEE addressing.
- Support for critical latency devices, such as joysticks.
- CSMA-CA channel access.
- Automatic network establishment by the coordinator.
- Fully handshaked protocol for transfer reliability.
- Power management to ensure low power consumption.
- 16 channels in the 2.4GHz ISM band
- Low duty cycle - Provides long battery life
- Low latency
- Support for multiple network topologies: Static, dynamic, star and mesh
- Direct Sequence Spread Spectrum (DSSS)
- Up to 65,000 nodes on a network
- 128-bit AES encryption – Provides secure connections between devices



C. Gas Sensor

Sensitive material of MQ-5 gas sensor is SnO₂, which with lower conductivity in clean air. When the target combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-5 gas sensor has high sensitivity to Methane, Propane and Butane, and could be used to detect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it is with low cost and suitable for different application.



Fig 3.7 GAS SENSOR

D. Liquid Crystal Display

A liquid crystal display (LCD) is a thin, flat panel used for electronically displaying information such as text, images, and moving pictures. Its uses include monitors for computers, televisions, instrument panels, and other devices ranging from aircraft cockpit displays, to every-day consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones.

E. Light Sensor

A light dependant resistor also know as a LDR, photo resistor, photoconductor or photocell, is a resistor whose resistance increases or decreases depending on the amount of light intensity. LDRs (Light Dependant Resistors) are a very useful tool in a light/dark circuits. LDRs can have a variety of resistance and functions. For example it can be used to turn on a light when the LDR is in darkness or to turn o_ a light when the LDR is in light. It can also work the other way around so when the LDR is in light it turns on the circuit and when it's in darkness the resistance increase and disrupts the circuit.



Fig 3.12 Light sensor (LDR)

RS-232 basics

RS-232 (Recommended Standard 232) is a standard for serial binary data signals connecting between a DTE (Data terminal equipment) and a DCE (Data Circuit-terminating Equipment).

F. Adc Convertor

Normally analogue-to-digital converter (ADC) needs interfacing through a microprocessor to convert analogue data into digital format. This requires hardware and necessary software, resulting in increased complexity and hence the total cost.

The circuit of A-to-D converter shown here is configured around ADC 0808, avoiding the use of a microprocessor. The ADC 0808 is an 8-bit A-to-D converter, having data lines D0-D7. It works on the principle of successive approximation. It has a total of eight analogue input channels, out of which any one can be selected using address lines A, B and C. Here, in this case, input channel IN0 is selected by grounding A, B and C address lines.

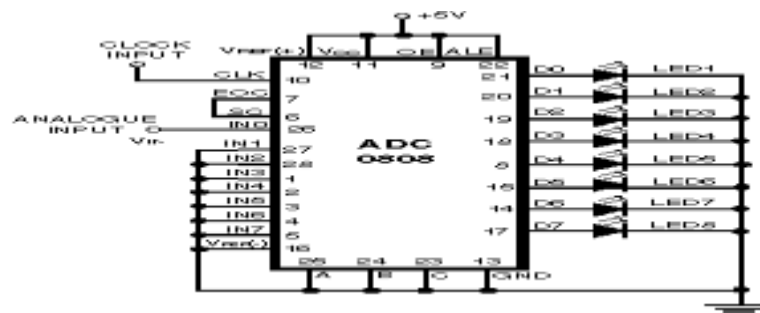


Fig 3.16 ADC

G. Relays

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contact. Since a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

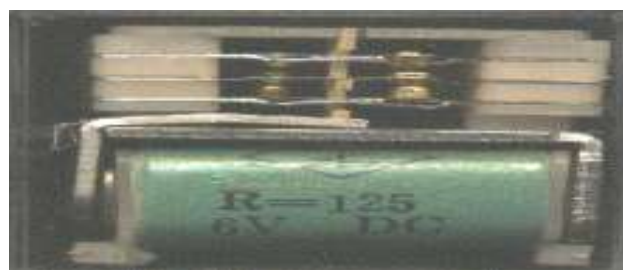


Fig 3.17 RELAY

III. SOFTWARE REQUIREMENTS

A. Express PCB

Breadboards are great for prototyping equipment as it allows great flexibility to modify a design when needed; however the final product of a project, ideally should have a neat PCB, few cables, and survive a shake test. Not only is a proper PCB neater but it is also more durable as there are no cables which can yank loose. Express PCB is a software tool to design PCBs specifically for manufacture by the company Express PCB (no other PCB maker accepts Express PCB files). It is very easy to use, but it does have several limitations.

- It can be likened to more of a toy than a professional CAD program.
- It has a poor part library (which we can work around)
- It cannot import or export files in different formats
- It cannot be used to make prepare boards for DIY production Express PCB has been used to design many PCBs (some layered and with surface-mount parts).

B. Keil u Vision4 software

The μ Vision IDE from Keil combines project management, make facilities, source code editing, program debugging, and complete simulation in one powerful environment. The μ Vision development platform is easy-to-use and helping you quickly create embedded programs that work. The μ Vision editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

Flash Magic

Flash Magic is a tool which is used to program hex code in EEPROM of micro-controller. It is a freeware tool. It only supports the micro-controller of Philips and NXP. It can burn a hex code into that controller which supports ISP (in system programming) feature. Flash magic supports several chips like **ARM**

Cortex M0, M3, M4, ARM7 and 8051.

Flash Magic is an application developed by Embedded Systems Academy to allow easily access the features of a microcontroller device. With this program it can erase individual blocks or the entire Flash memory of the microcontroller. The kit can be programmed through serial port using 'Flash Magic'. 'Flash Magic' is a freeware windows utility used download the hex file format onto the kit. The Flash Magic utility is provided in CD along with the KIT. If your PC does not have a serial port; use a USB to serial converter to download the hex file using the Flash Magic utility

V. PROJECT IMPLEMENTATION

5.1 Sensors

(a)Temperature Sensor

Temperature sensor is used to sense the temperature. We have used a Temperature sensor called LM35. Irrespective of the application to which it is used, it gives the reading of the temperature. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. Temperature sensor is an analog sensor and gives the output into form of analog signal. This signal is feed to ADC which will convert it into digital form.

(b)Gas Sensor

Gas sensor we are using is MQ-6. Sensitive material of MQ-6 gas sensor is SnO₂, which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is more higher along with the gas concentration rising. MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane, it is with low cost and suitable for different application.

Gas sensor is an analog sensor and gives the output into form of analog signal. This signal is feed to ADC which will convert it into digital form.

5.2 ARM controller (LPC2148)

In this project,LPC2148 will connected by the inputs called Vibrations Sensor and output like LCD,GSM,GPS& Motors and also some peripherals. According to the program & data which is received from vibration sensor the controller will performs the estimation of the accidents of the vehicle and also send that GPS data to our mobile using GSM module & GPS module which is interface to it whenever it is in emergency.

5.3 Message format on LCD

LCD used in a project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can

display on 16x2 LCD. LCD can also be used in a project to check the output of different modules interfaced with the microcontroller. Thus LCD plays a vital role in a project to see the output and to debug the system module wise in case of system failure in order to rectify the problem

5.4 Zigbee

Zigbee is a new wireless technology based on wireless standard 802.15.4. It is an extension of the WPAN, having significant features:-

Short Range: - Which is between 10-100 m, good enough to meet the need of mobility equipment.

Low Power:-When data exchange is not needed the node will enter a very low power consumption sleep mode Low Transmission Rate . Compared to Bluetooth & Wi-Fi , Zigbee technology has following advantage

1) Good Security:-Zigbee provides data validation capabilities, using AES 128 encryption algorithm

2) Low Cost:-Data transmission rate is low,the protocol is simple ,it costs much less & free of royalties.

3) Low power Consumption: - Particularly in standby mode to save energy.

4) Short Delay:-Usually between 15 &30 msec.

5) Low Transmission Rate:-Only 10 to 250 k bytes/sec, for low data rate n/w's.

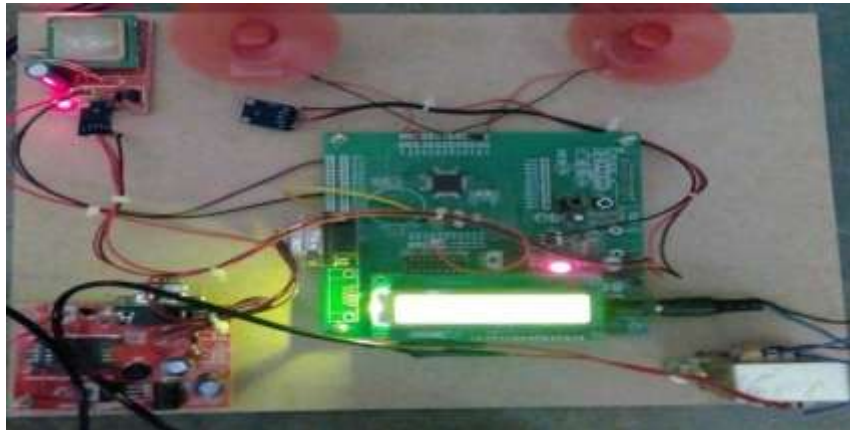
6) Flexible working BW :- Using frequency bands for 2.4 GHz,868 MHz, 915 MHz, all are license free band.

7) Large n/w Capacity: - Each zigbee n/w can support up to 255 devices

5.5 RS 232

RS 232 is a serial communication cable used in the system. Here, the RS 232 provides the serial communication between the microcontroller and the outside world such as Display, PC or Mobile etc. So it is a media used to communicate between Microcontroller and the PC.

VI.RESULT



This system works when the vehicles met an accident and then it calculates the severity by using vibration sensor which is present in it. Then it sends the values to ARM controller.The Controller will compare the values of severity if it is more then it trace the location by using GPS.GPS provides location information to controller whenever it required and then send this location and severity values to the rescue unit by using GSM module. GSM module is already connected to the controller then rescue unit will as per location they received from GSM and will provide the necessary service they need

VII. CONCLUSION AND FUTURESCOPE

Conclusion

In summary, zigbee wireless smart sensor platform is a new close range, simple low power, low data rate & low cost technology. It is based on IEEE 802.15.4 std. In our system we uses various features like Co-operative Communication whose goal is to increase communication rate & reliability .also we are using dedicated mobile to give the SMS. Here we can also add the no. of slaves, the idea is that if the slave goes out of range of PC master then the communication fails. All slaves placed in such a way that they will be always in range of the PC master. (ie we can use feature of collision avoidance protocol).

Future scope

Future research &development may continue to be focused on further improvements of the reliability & responsiveness & technology advancement on energy saving, power management, fault tolerance & smart routing.

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