ARM Based Wireless Data Acquisition

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Abstract: Short distance data collection processes have problems. These can be termed as the repetition of work at many steps, complexity involved in cable connections; the need of real time data processing and the electromagnetic interference etc. We are proposing design of the system of data acquisition using LPC1768 and virtual instrument. The system leverage Cortex-M3 core ARM processor for performing the data acquisition of the closed environment, use the Bluetooth serial port module to implement the wireless data transmission, and use the virtual instrument to handle the received data in the host machine. The system is recommended for wireless data collection, the wireless hand-held meter reading and the industrial real time information collection.

Keywords: Wireless communication; Bluetooth serial port; Virtual instrument.

Introduction

Wireless communications technologies are continuously evolving over the last few decades and as any technology is for the betterment of human life so application of technology is next step of it. The currently well known wireless communication technologies are Bluetooth, Wi-Fi, zigbee, IrDA, GSM etc. There are many problems in any data collection process, this data can be anything. Typical problems involving in these are repetitive human work which seeds the error, complex cable connections, need of real time data processing and electromagnetic interference arising due to various electromagnetic mediums. If we consider the application range of various techniques, the cost involved in the data transmission, security factors, reliability and other parameters, Bluetooth communications and wireless sensor networks are the most appropriate method in short range wireless communication and data transmission. Further, the Bluetooth technology can solve the problems mentioned above. The proposed system shown here is making use of Bluetooth communication technology for wireless data transmission, uses multiple sensors for data collection, and uses the virtual instrument software to monitor and process the data arrived at all nodes .Multi-channel data acquisition, higher processing speed of the software based on the short-range wireless data collection are the advantages of this system. System can be widely used in many fields, such as short-range wireless data collection, handheld meter reading and industrial real time information collection.

## The principle of the wireless data acquisition system
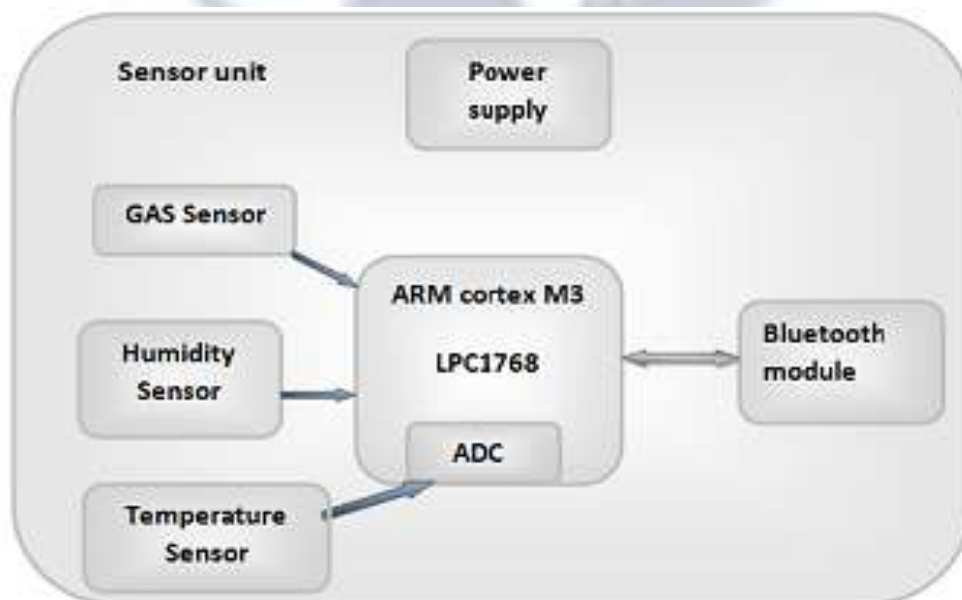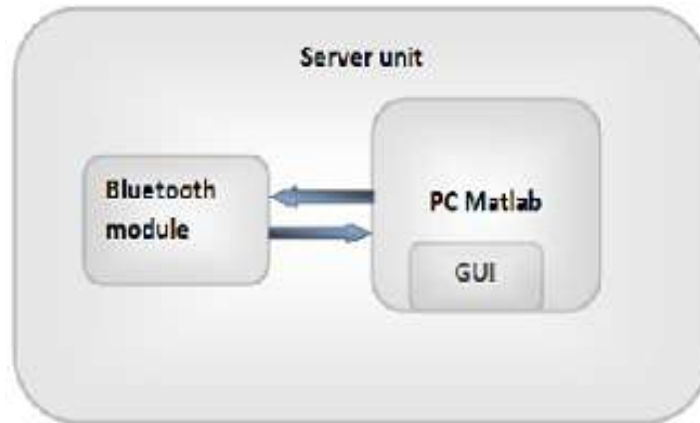
Wireless data acquisition system comprises of two parts, the part of the data acquisition and the part of the data processing in the host computer. The data acquisition part of the sensor circuit handles the important task of receiving the external signals, and these changeable signals can be amplified through the amplifier circuit. Sensor circuit includes GAS sensor, Humidity sensor and temperature sensor. Gas Sensors are from MQ Series .The amplified signal will undergo a process

of AD conversion through the peripherals of the microprocessor LPC1768, which have a 12-bit high-resolution ADC. According to the requirements of the PC software, the converted data can be the collected for real-time transmission, or stored in FLASH, waiting for the host computer to read. The wireless data collection systems also provide serial bus interface, which is used to connect the serial bus sensor. 3.3V power supply provides the power to data acquisition system. In the machine i.e personal computer, there is a Bluetooth serial port receiver module, which is responsible for receiving all the data returned from the slave machine. The data received from the slave unit will be accumulated on PC and can be plotted graphically using MATLAB.

We have selected the ARM micro controller to develop embedded PLC. The reason behind this is its wide use across many embedded designs due to competitive price, low power consumption, and wide variety of peripherals available. LPC1768 micro controller of ARM cortex M3 will be used

Details of the component Used in the proposed system
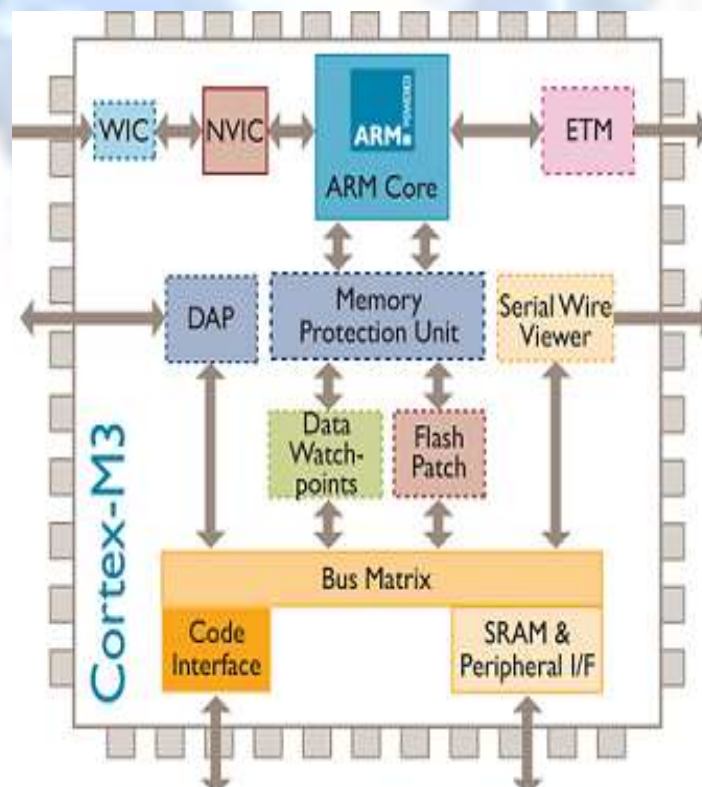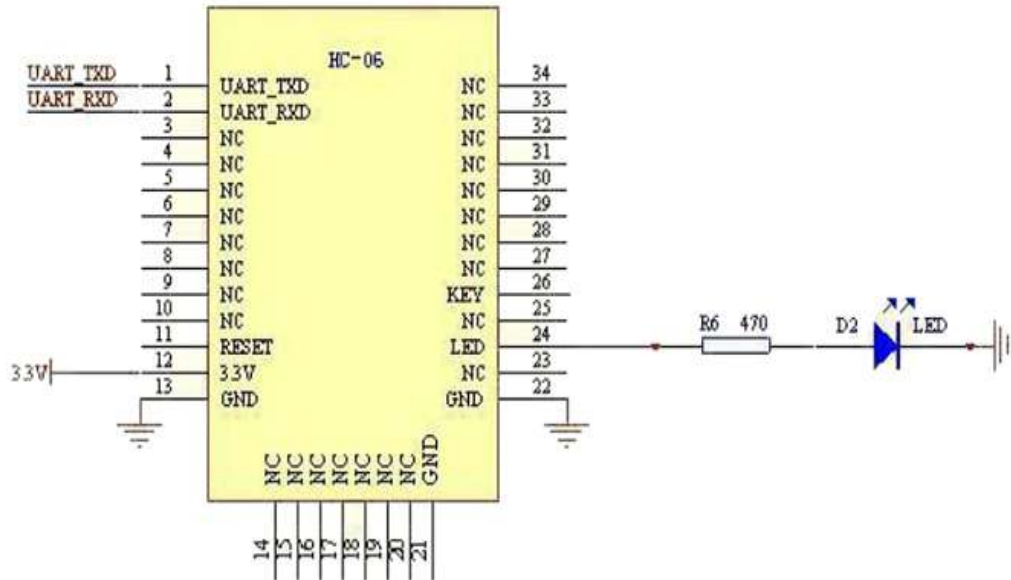
ARM Cortex-M3 processor, running at frequencies of up to 100 MHz. A Memory Protection Unit (MPU) supporting eight regions is included.

- ARM Cortex-M3 built-in Nested Vectored Interrupt Controller (NVIC).
- Up to 512 kB on-chip flash programming memory. Enhanced flash memory accelerator
- enables high-speed 100 MHz operation with zero wait states.
- In-System Programming (ISP) and In-Application Programming (IAP) via on-chip
- Boot loader software.
  On-chip SRAM includes
- 32/16 kB of SRAM on the CPU with local code/data bus for high-performance CPU access.
- Two/one 16 kB SRAM blocks with separate access paths for higher throughput.
  These SRAM blocks may be used for Ethernet (LPC1768/66/64 only), USB, and DMA memory, as well as for general purpose CPU instruction and data storage.LPC1768/66/65/64
- 32-bit ARM Cortex-M3 microcontroller; up to 512 kB flash and 64 kB SRAM with Ethernet,
- USB 2.0 Host/Device/OTG
- CAN
- 32-bit ARM Cortex-M3 microcontroller

Sensors we are using:

1.Gas sensor – MQ-5

2.Humidity sensor – SY-HS-220

3.Temperature sensor – LM35

Communication media

Bluetooth module- HC-06

Details of software required:

- Keil software will be used for programming
- Diptrace will be used to design layout

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide. The Gas Sensor(MQ5) module is useful for gas leakage detection (in home and industry). It can detect LPG, natural gas, town gas and so on. Because it has a fast response time once it has pre-heated, measurements are almost instantaneous. Note that the sensitivity can be adjusted by the potentiometer Features

- High sensitivity to LPG, natural gas, town gas

- Low sensitivity to alcohol and smoke

- Fast response

- Stable and long life

    Application

- Gas leakage detection

- Toys

    This sensor module converts relative humidity (30-90%RH) to voltage and can be used in weather monitoring application.

Software Design, advantages, disadvantages

The wireless data acquisition software consists of two parts. The first one is the driver involved in the hardware, which includes the driver of the gas sensor, Humidity sensor, Temperature sensor. The Cortex-M3 and its peripherals, drive configuration of the Bluetooth Serial Module. In the hardware drivers, each one must be properly configured. The most complex drivers are the Cortex M3 driver and the driver of the Bluetooth chip. The second one is the Mat lab PC software programming on the PC side. The host computer software controls each Bluetooth node and can enable data transmission and data processing. In the pc software design, the core is the VISI hardware interface driver. The wireless data acquisition system uses the VISI's serial port driver to communicate with the wireless transmission module

Advantages:

1. Low cost and reliable

2. Can be programmed using embedded C.

3. Real time data processing can be achieved with less complexity in hardware

4. Because of wireless system, data can be accessed from anywhere

Disadvantages:

1. System may fails in the absence of electricity or on the discharge of battery

2. Calibration of sensors is needed

3. Transmission of data can be interrupted if Bluetooth is out of range

Results Obtained and Future Scope

As described above system is built using standard design process. In order to process and display the values received from sensors we have designed MATLAB UI. Here interface developed clearly shows the variations obtained in the parameter selected. These variations are directly proportional to change in their values. Please see below for these results.
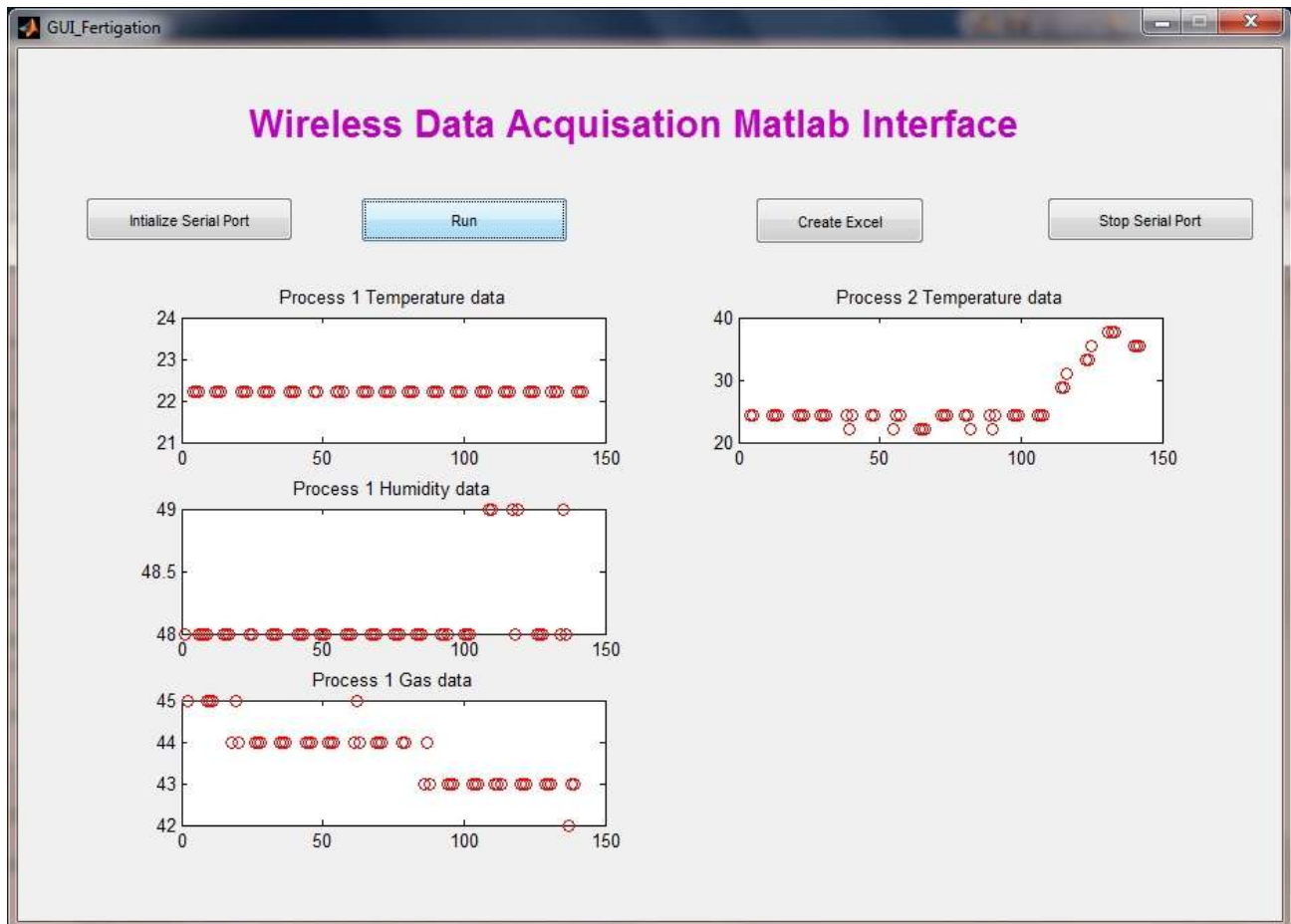
We have also given feature to write this data to excel sheet. This captured data in excel sheet can be used for analytics purpose. This analytics may be of any type to arrive at conclusion. The future scope for this project is we can add any parameter in it. We have to design a suitable part to add that parameter and provide it's output to ADC of the ARM processor. In this manner, we are increasing the scalability of the system. This unit can be fit in to any industry. Considering the current parameters, it can be applied to chemical plant where temperature, humidity and gas are the major parameters

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