IMPLEMENTATION OF SMART INDUSTRIAL AUTOMATION SYSTEM USING EMBEDDED WEB

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ABSTRACT: *For industry, to overcome requirement of more resources and man power, it is required to design an embedded system which realizes monitoring and controlling of all industrial parameter. In addition to that, this system will also provide cost effective solution. By installing sensors at different group of nodes it controls different outdoor and indoor parameter. For this entire task to install and control, main part of the system is Embedded Web Server (EWS) which controls all the task smartly by programming an operating system. So the proposed work is multi-parameter data acquisition system for controlling and monitoring industry parameter and working units.*

Keywords—Embedded Web Server (EWS), TCP/IP, Zig-Bee, Microcontroller, Multi-Network environment.

I: INTRODUCTION

During the recent past, significant progress in the field of embedded technology, and Embedded Web Server based technology is gradually becoming established as an efficient tool in all types of controlling and smart design. Embedded web server or its web services has offered enormous benefits to Education, Consumer market and Industry. It has the potential to explore many fields practically. Embedded server has many more primitive merits. Some of them are listed here.

- Remote monitoring of residential and industrial properties and notifications [2]-[5].
- Medical application - RFID based multi-parameter data collecting system [6].
- Industrial automation service oriented paradigms [1].

Excepting above mentioned parameter there are also few practical applications are there for which we need to integrate different technology and different fields. By designing this system its immunes approach to achieve some features like control of complete embedded system centrally, web based parameter collecting and debugging, representation of all the measured parameter through internet browser.

II: HARDWARE ARCHITECTURE

A. TRANSMISSION NODE ARCHITECTURE

In transmitter as shown in Fig.1 sensor module (gas sensor [8], temperature sensor [12] and RPM measurement) of are used for parameters measurement. All the measured data needs to be used for operation, which is analog so it is necessary to convert it in digital form. So sensor modules are interfaced with microcontroller PIC18F4520 [10] which have on-chip ADC for data digitization. By the use of serial communication (UART) data is serially transmitted to ZigBee [9]. And from ZigBee, data is transmitted wirelessly from each transmitter module to centrally located receiver node EWS.
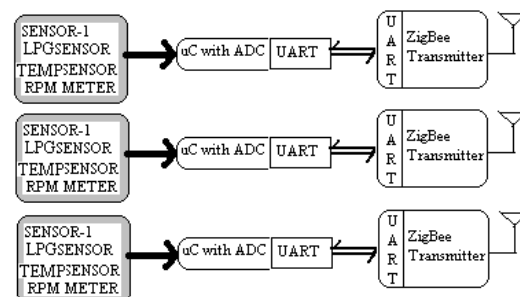

Figure.1. Block diagram of transmitter

B. RECEIVER NODE ARCHITECTURE

At the receiving end, the ZigBee receiver receives the data transmitted at specific interval. This interval can be configured according to the requirement of user.

Figure.2. Block diagram of receiver

The received data is stored in the server database memory. This received data can be sent via LAN/WAN. By web browser user sends request to EWS for data of different sensors. Generated response will be representing to HTML pages on browser which display different parameters. For this network based operation TCP/IP [14] protocol stack manages entire transmission and reception. Embedded web server and browser client builds TCP/IP application.

III: EMBEDDED WEB SERVER (EWS)

For EWS, we can define scalability in controlling all the task parallel and accuracy in measured parameter by connecting as much as transducers, capability to increase processing power and by increasing HTML pages for the purpose of to provide more controlling GUI (graphical user interface) and security against unauthorised user.

A. FEATURES OF THE RCM4200

For practical application implementation purpose following features of RCM4200 [11] is mainly constructive.

- Microprocessor: Rabbit running at up to 58.98 MHz
- 3.3 V I/O lines with low-power modes down to 2 kHz
- Up to 28 or 36 general-purpose I/O lines configurable with up to four alternate functions
- Up to six CMOS-compatible serial ports — four ports are configurable as a clocked serial ports (SPI), and one or two ports are configurable as SDLC/HDLC serial ports.
- Alternate I/O bus can be configured for 8 data lines and 6 address lines (shared with parallel I/O lines), I/O read/write
- Up to 2 MB flash memory, up to 1 MB fast program-execution SRAM, and 512K data SRAM
- Combinations of up to eight single-ended or four differential 12-bit analog inputs

- Real-time clock
- Watchdog supervisor

B. EMBEDDED SERVER PROCESSING STATES

Figure.3. Server processing states

Function of embedded server is to check for initial login. After successfully login check for connection and also check for all interfaces. Then processor will parse IP request. If it will found any error or wrong request then it will quit immediately. And if IP is mapped to the database, it will generate data according to the request. In this design of server there is also two way communication facility. So by using HTML pages one can observe parameter and also can control if necessary.

IV: HARDWARE IMPLIMENTATION & RESULTS

According to our architecture block diagram in session II, implemented hardware is presented here. Below it is given transmitter implementation and receiver side server implementation.

A. TRANSMITTER IMPLIMENTATION

Figure.4. Transmitter interfacing circuit

In above Fig.4 it is controller PIC18F4520 is interfaced with gas sensor, LM35 and for wireless

transmission ZigBee is interfaced. And for RPM measurement and control, remaining task is to interface motor and RPM measurement logic. For programming of PIC controller software tool which I have used is microC PRO. microC tool [18] have features like compiler, simulator, debugger, UART terminal, UART Bootloader, memory editor etc. Fig.5 shows screenshot of microC PRO tool.
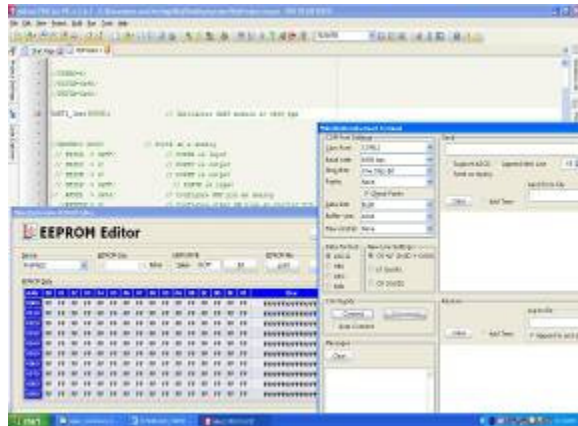
B. RECEIVER IMPLIMENTATION (EMBEDDED SERVER)

Figure.5. Block diagram of receiver

In above Fig.5 it is a basic board with RCM4200 server. Server is interfaced with cables, one is connected with online loader and another one connected to ZigBee module. For the programming of server DYNAMIC C [16]-[17] tool is uses. DYNAMIC C provides facility of compilation and loading from the same environment. This Tool is also have other features like Debugging, keep watch on specific variable or process, loading of final generated file in RAM, FLASH according to requirement, mainly useful feature is help which contains complete library detail and all the syntax of useful function. Fig.5 shows screenshot of DYNAMIC C tool.
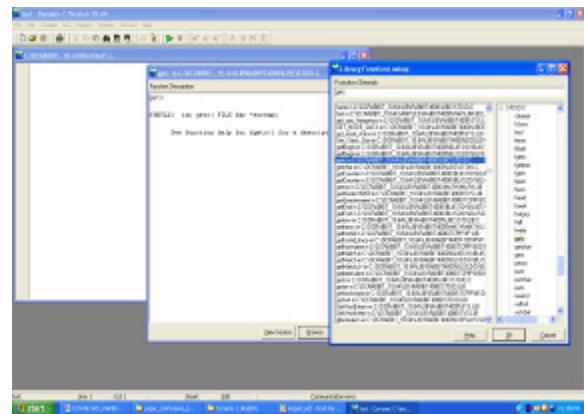
Figure.5. DYNAMIC C TOOL screenshot

V: WIRELESS TECHNOLOGY & TCP/IP

A. ZigBee ARCHITECTURE BLOCK DIAGRAM
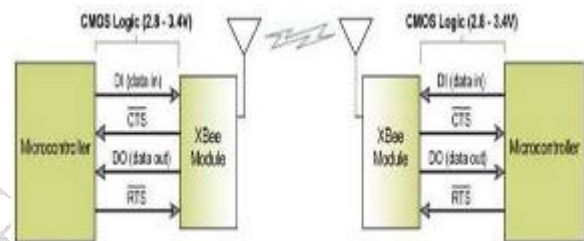
Figure.6. ZigBee trans-receiver Block-diagram

Fig.6 [15] represents block diagram for the data transmission and reception between all the transmission node and centrally located EWS based reception node. Here ZigBee [9] is used for trans-receive because of its plenty of advantages, low power requirement, data security, long indoor/outdoor range.

B. ZigBee SPECIFICATION

- Indoor Range up to 100ft (30m)
- Outdoor RF line of sight range up to 300ft (100m)
- Transmit output power 1mW
- RF data rate 2,50,000 bps
- Serial interface Data rate 1200-115200 bps
- Receiver sensitivity -92dBm (1 % packet error rate)
- Supply voltage 2.8-3.4 V
- Transmit current 45mA
- Receive current 50mA
- Operating frequency ISM 2.4 GHz
- Supported network topologies
  - Point to point
  - Point to multi point
  - Pear to pear

VI: CONCLUSION

By designing system one can measure all the required parameter and by using wireless technology system sends all the data in a specific format towards Embedded Web Server. Server stores data in database and also retrieve when receives request from browser. For implementation of this system various technology elaborations is required, which are controller, TCP/IP, sensor network for data collection, for wireless ZigBee at both end, at receiver end RCM4200 server. For programming different tools are used. For PIC programming microC PRO tool is used and for programming of EWS (RCM4200) Dynamic C tool is used. For security purpose password is also required to access HTML pages. With the help of such Embedded system user can monitor and access system locally and remotely by LAN or WAN.

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