INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS.....

Zigbee-Wi-fi Transmission Scheme for Smart Grid Applications

Y.Phanindra[1], K.Radha[2]

[1]PG student, Department of Electronics and Communication Engineering,
VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India
phanindra195@gmail.com

[2]Assistant Professor, Department of Electronics and Communication Engineering,
VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India
radhakodirekka@gmail.com

Abstract: Real time monitoring is the current need of industries and is also becoming a necessity for household purposes. The main purpose of such monitoring is for security or to be prepared and avoid damage in case of a human error or naturally triggered events. Though there is considerable progress in this field, the monitoring is done locally. This paper describes about increasing the range of monitoring by transmitting the acquired values to a considerable distance by using zigbee and placing the data on a web server so that persons in the wi-fi range can access the data and control it. The proposed system uses 8051 as basic controller for transmitting data from a remote location via zigbee and at the reception end ARM 9 is used to display the acquired values on a graphical LCD for verification purpose and also place them on to an embedded web server. Embedded Linux is used as the operating system for supporting the web server and also GUI built for LCD.

Keywords: Web server; ARM, GUI, Wi-fi.

1. INTRODUCTION

The internet or the world-wide-web (WWW) as we call it is evolving at a very fast pace. It is clear that its underlying technologies are useful for much more than just browsing the web. A web server can be embedded into any appliance and connected to the internet so that the equipment can be monitored and controlled from remote places. This paper introduces a solution for embedded system access to internet through which remote access, monitor and control can be possible. Thus it includes both web and embedded technologies. The proposed design consists of two modules. In the first module three sensors namely Light, Temperature and Gas are interfaced to 8051 board. The data from sensors is to be gathered by 8051, and then the collected data is transmitted through zigbee. The second module consists of a friendly ARM board with an S3C2440 chip. This board has to receive the data transmitted by zigbee and the received data has to simultaneously display by the graphical LCD and also on web server. The core for achieving this is a S3C2440 processor on which the scissor down version of Linux is ported as to support GUI and web server applications.

2. HARDWARE SYSTEM DESIGN

The general hardware structure of the system is based on ARM processor as shown in below Fig 1.S3C2440 processor is used as core of the hardware. The system consists of an 8051 board, Friendly ARM and a wi-fi module.

2.1 S3C2440

The main frequency of S3C2440 is 400MHzand can achieve a peak frequency of 533MHz.The SDRAM capacity in the system is 64MB.It has a 32bit data bus and SDRAM clock frequency can reach up to 100MHz.S3C2440 has a flash memory which is divided into 64MB NAND flash and 2MB NOR flash [4].Since it has two memories, it supports two boot modes i.e., one from NOR and one from NAND. The NOR flash presumably contains boot-up files associated with the board and any other applications which are supposed to start up when the board is turned ON. The NAND flash consists of a much larger memory when compared to NOR. This is provided to support user specific applications to run on the board. These can range from simple applications to very complex ones such as multiple GUI's or graphic intensive apps. For supporting the boot Loader in the NAND flash a buffer named Steppingstone is present in RAM.

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

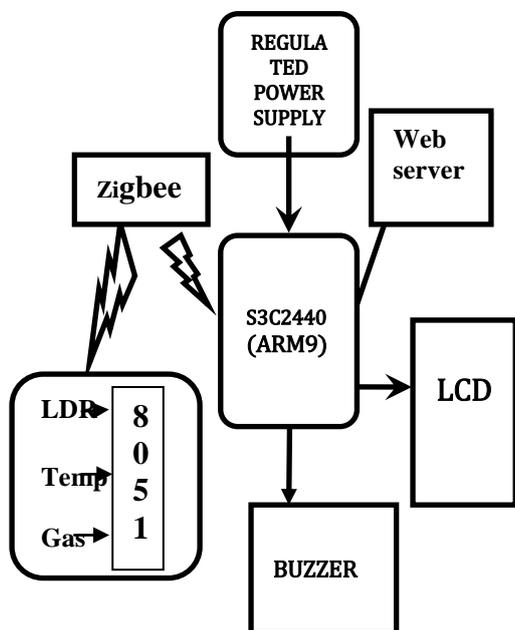*WINGS TO YOUR THOUGHTS.....*

Figure 1: Block Diagram of hardware.

NAND flash does not have the address line, it has a dedicated control interface connected with the CPU, for the 8-bit data bus, but this does not mean that NAND flash read and write data [4] will be very slow. Most of the USB or SD cards are made of NAND flash equipment.

2.2 Sensor board

Three sensors are interfaced to 8051.Since the data from sensors is analog it is given as input to analog to digital converter to digitise the values. Fig 1 shows the block diagram of the hardware being used in the system. The values obtained are ASCII values which have to be converted to integer form. Then these values are transmitted via zigbee through 8051.

2.3 Zigbee

ZigBee is a specification for a suite of high level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15 standard. Though low-powered, ZigBee devices often transmit data over longer distances by passing data through intermediate devices to reach more distant ones[3], creating a mesh network i.e., a network with no centralized control or high-power transmitter/receiver able to reach all of the networked devices. The friendly arm board doesn't consist of a built in zigbee so it has to be interfaced externally.

2.4 Friendly ARM

The data acquired has to be continuously updated both on the screen and on web server. To accomplish this Friendly ARM mini2440 is used. This is chosen because of the inbuilt features available in it and the processing power the ARM core has to offer. Embedded Linux is chosen as the operating system because it is a freeware and has to act as a base for GUI and web server. The serial ports on the board have different logic levels than those from 8051. So a logic level conversion is necessary for hassle-free communication from one end to another.

Figure 2: Friendly ARM.

2.5 Wi-Fi module

The wi-fi module used here consists of a ATHEROS AR9285 chip which is compatible with both 802.11g and 802.11n standards with a speed of up to 150Mbps.The webpage design ported on to ARM board is transmitted through this chip. Though the initial prototype design contains only data from a single board. In real time application there will be several units from which the data has to be transmitted. To cope up with future updates a wi-fi module with inbuilt memory chip is chosen so that multiple values that are received can be stored in this memory and then transmitted. Multiple web pages cannot be streamed without a separate memory interfaced to the wireless chip. So a separate SDRAM is used to save each webpage on to the memory.

3. SOFTWARE DESIGN

Software development process based OS includes the establishment of cross-compiler, the creation of root file system and the transplant of boot loader, porting of scissored down version of Linux as to suit the application. GCC is a cross compiler Supervising is the boot-loader licensed by Samsung for the S3C2440 board. Fig 3 shows the workflow of the system from acquiring the data from sensors to placing it in the web server.

3.1 Qt creator

QT is a cross-platform application framework that is widely used for developing application software with a graphical user interface and also used for developing non-GUI programs such as command-line tools and consoles for servers. QT uses standard C++ but makes extensive use of a special code generator together with several macros to enrich the language. It can also be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. It has extensive internationalization support. Non-GUI features include SQL database access, XML parsing; thread management, network support, and a unified cross platform application programming interface (API) for file handling.
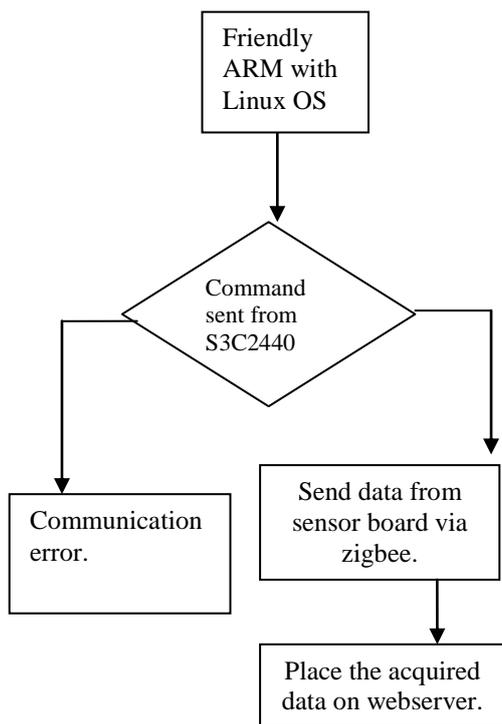
```
┌─────────────┐
│ Friendly    │
│ ARM with    │
│ Linux OS    │
└─────────────┘
       │
       ▼
   ◇ Command ◇
   ◇ sent from ◇
   ◇ S3C2440 ◇
   ◇        ◇
  │          │
  ▼          ▼
┌──────────┐  ┌──────────────┐
│Communica-│  │ Send data from│
│tion      │  │ sensor board  │
│error.    │  │ via zigbee.   │
└──────────┘  └──────────────┘
                     │
                     ▼
              ┌──────────────┐
              │ Place the     │
              │ acquired      │
              │ data on       │
              │ webserver.    │
              └──────────────┘
```

Figure 3: Flowchart

3.2 Web server

General web servers which are developed for general purpose computers such as NT servers or UNIX and LINUX workstations [1], typically require megabytes of memory, a fast processor, pre-emptive multitasking operating systems and other resources. A web server can be embedded in a device from web browser [6] if the resource requirements of the web server are reduced. The main use of web server is to convey the current state information of embedded systems, such as a systems [5] working condition configuration to a web browser. It can also be used to control or transfer user commands from a web browser to an embedded system.

3.3 Linux

Embedded Linux is used as the operating system as it provides high security to drivers and files [7]. The OS will perform functionalities like file management, process management, memory management, network management. Also the drivers related to the components are readily installed when porting Linux on to the board.

Steps in porting Linux:

- Building tool chain: Using a cross compiler like gcc to configure parameters as per required specifications.
- Compiling kernel by using command menu config [8] and packing it into an image namely zim age.
- Set serial port settings.
- Installing boot-loader by formatting any existing ones.
- Load kernel on to board with help of boot-loader.

4. WORKING

Sensors are interfaced to an 8051 microcontroller. Then the data from8051 is transferred via zigbee. Fig 4 shows the interfacing of sensors to AT89S52.

Figure 4: Sensor board.

Likewise data from multiple boards is transmitted to a single central zigbee and then to the S3C2440 serial ports which can be either ttsy 0,1,2.The friendly ARM board does not contain inbuilt zigbee module, so one has to interfaced externally as shown in Fig 5 to receive from other end. A GUI is designed using QT

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN

ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS.....

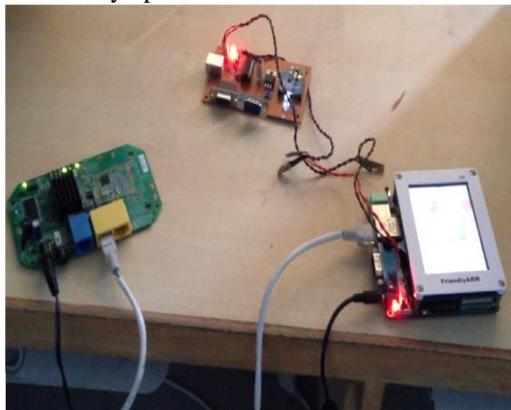for displaying on a 3.5" LCD and has to be simultaneously updated in the web-server.

Figure 5: ARM9 board with Zigbee interfaced

5. RESULTS

The below web page in Fig 6 shows the values of the sensors along with control options on the side. This is accomplished by entering the ip address of the Friendly ARM board on the address bar of the page. Then the web server ported on to the ARM board is transmitted via wi-fi and displayed on the web page.
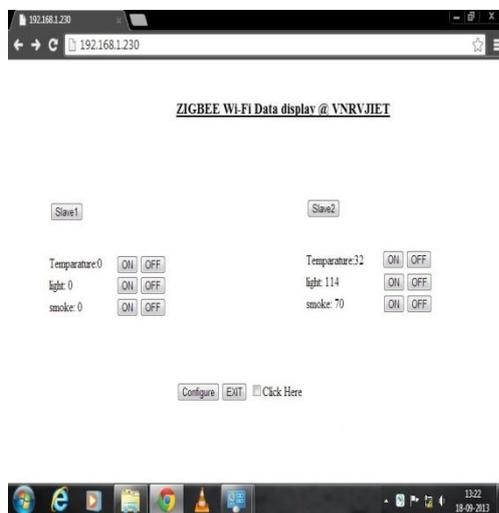

Figure 6: Webpage.

6. CONCLUSION

A transmission scheme of acquiring data through zigbee and transmitting it through wi-fi for viewing the data on a web server has been successfully implemented. The proposed scheme is mainly targeted at use in coal mines. It can also used in medical applications for real time monitoring of people from a distant location.

REFERENCES

[1] Mo Guan and Minghai Gu, "Design and Implementation of anEmbedded Web Server Based on ARM" 978-1-4244-6055-7/10/$26.00©2010 IEEE.

[2] Hong-Taek Ju, _ Mi-Joung Choi and James W. Hong "An efficient andlightweight embedded Web server for Web-based network elementmanagement" International Journal of Network Management, pp. 261– 275, Oct 2000.

[3] Xianghua Xu, Daomin Yuan,JianWan.,"An Enhanced Routing Protocol for ZigBee/IEEE 802.15.4 WirelessNetworks", 2008 Second International Conference.

[4] Installation Manual for S3C2440.

[5] Manivannan M, Kumaresan N. "Embedded web server & gprs basedadvanced industrial automation using linux rtos" Vol. 2(11), 2010,6074-6081, ISSN: 0975-5462.

[6] V.Billy Rakesh Roy, Sanket Dessai, and S. G.Shiva Prasad Yadav."Design and Development of ARM Processor Based Web Server"International Journal of Recent Trends in Engineering, Vol. 1, No. 4,May 2009,pp 94-98.

[7] "Building Embedded Linux Systems" By Karim Yaghmour.

[8] "Embedded Linux" By Chris Hallaughbagh.