ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Real Time Implementation of Home Automation Using FPGA

Mendi Sadanandam
M.Tech (VLSI- SD)
Department of ECE
J. B. Institute of Engineering and Technology, Hyderabad, Telangana, India.

G.Anand, M.E, Ph.D
Associate Professor
Department of ECE
J. B. Institute of Engineering and Technology, Hyderabad, Telangana, India.

Abstract:
This home automation system mainly focused on the design and implementation of a system that control various appliances at home. The design is having FPGA as its heart and this controller board is connected to the server at the home. Various home appliances are connected to system board with the input/output port. Most of the sensors & transducers such as temperature, gas are analog. For interfacing these sensors to FPGA require to convert the analog output of these sensors to digital so that the controller can read it. This system is scalable as new appliance can be added with small change in core system appliances can be controlled.

Keyword: ***FPGA, Home Automation, Sensors***

Introduction:

One of the most effective modern technologies for home safety is a security system. These systems monitor the most critical areas of the house in order to detect intrusions or other anomalies that might otherwise go unnoticed. During recent past, a number of systems were introduced for security measurements based on wired networks. In literature, researchers suggested a number of security systems based on new technologies like GSM (Global System for Mobile communication), USN (ubiquitous sensors network) and implemented through FPGA (field programmable gate arrays), DSP (digital signal processor), and MCU (microcontroller unit). A Java based home automation system is developed. An embedded board physically connected all the home automation devices and, through integration with a personal computer (PC) based web server, provided remote access to the system. The use of Java technology, which incorporates built-in network security features, produces a secure solution. However, the system requires an intrusive and expensive wired installation and the use of a high end PC [1]. Introduced a Bluetooth based home automation system, consisting of a primary controller and a number of Bluetooth sub-controllers. Each home device is physically connected to a local Bluetooth sub controller.

The home devices communicate with their respective sub-controller using wired communications. From the sub-controller all communications are sent to the primary controller using wireless communications. It is desirable for each home device to have a dedicated Bluetooth module. However, due to the fiscal expense of Bluetooth technology, a single module is shared amongst several devices. This architecture reduces the amount of physical wiring required and hence the intrusiveness of the installation, through the use of wireless technology.

Home Automation systems are commonly found in electronic form today. A system of sensors is connected to a controller, which in turn connects to a GSM. Remote sensing has many applications in real life; One of these applications is for home automation. We are introducing the design of a controller with low cost and large number of inputs and outputs that can be used either for controlling or sensing the remote devices. The system is based on designing and implementing an FPGA chip that is interfaced with a GSM MODEM to work together as a remote sensing and control system at the same time. The hardware of the controller chip has been designed using VHDL and has been tested using Xilinx FPGA. First a synthesizable VHDL code has been written and

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

simulated using Xilinx ISE 10.1i tools, and then implemented on a Xilinx Spartan 3 FPGA.

Implementation:

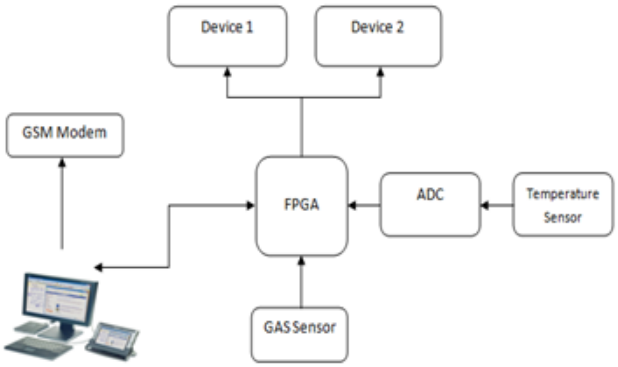


Fig: Block Diagram of Home Automation

The architecture of the system mainly consists of three main components as shown in Figure, the controller, GSM, and the remote devices and sensors. The controller connected to the different types of sensors and devices. The FPGA will transmit the information to the Server(PC) where it shows the display and whenever any sensor sensed the an SMS alert will be sent to the Owner.

Modules Used:

Gas Sensor

Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick repsonse time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke.

Applications

- Gas leak detection system
- Fire/Safety detection system
- Gas leak alarm
- Gas detector

Features

- High Sensitivity
- Detection Range: 100 - 10,000 ppm iso-butane propane
- Fast Response Time: <10s
- Heater Voltage: 5.0V
- Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High

Temperature Sensor - The LM35

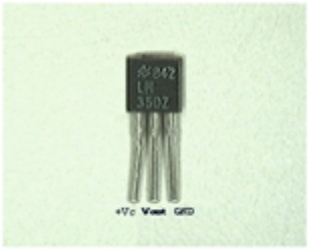
The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature

Features

Calibrated directly in ° Celsius (Centigrade)
Linear + 10.0 mV/°C scale factor
0.5°C accuracy guaranteeable (at +25°C)
Rated for full −55° to +150°C range
Suitable for remote applications
Low cost due to wafer-level trimming
Operates from4 to 30 volts
Less than 60 µA current drain
Low self-heating, 0.08°C in still air
Nonlinearity only ±1⁄4°C typical
Low impedance output, 0.1 □□for 1 mA load

The LM35 - An Integrated Circuit Temperature Sensor
LM35s To Measure Temperature:
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.'

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

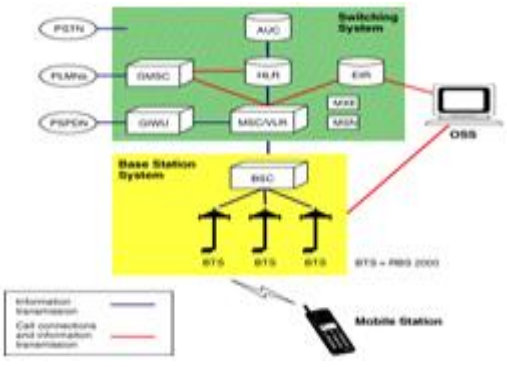


GSM MODEM:

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz.

THE GSM NETWORK

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS). The basic GSM network elements are shown in below figure



GSM Network Elements

GSM MODEM:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

•Reading, writing and deleting SMS messages.
•Sending SMS messages.
•Monitoring the signal strength.
•Monitoring the charging status and charge level of the battery.
•Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low -- only about six to ten SMS messages per minute.

Results:

Fig: Gas Sensor sensed information on PC

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Fig: Temperature Sensor sensed information on PC

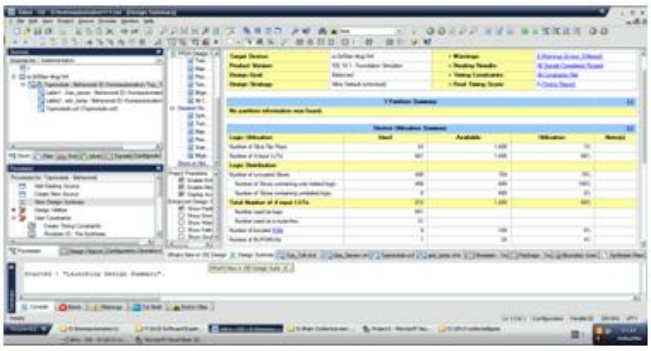


Fig: Synthesis Report on Xilinx ISE

CONCLUSION

In this paper we introduced a remote sensing and control system based on using Global System for Mobil (GSM) and FPGA. The system is suitable for a real time monitoring in home security as well as controlling and sensing in home automation with large number of controlled devices. The system has been design and implemented in hardware using VHDL language and Xilinx Spartan 3E FPGA. GSM has been used for testing the circuit either for the sensing part of the circuit or the control part. The design was simulated and verified the correctness and working operation of the whole system.

REFERENCES

[1] G. Aranguren, L. Nozal, A. Blazquez, and J. Arias, "Remote control of sensors and actuators by GSM", IEEE 2002 28th Annual Conference of the Industrial Electronics Society IECON 02, vol. 3 , 5-8 Nov. 2002, pp..2306 - 2310.

[2] Wu, Bing-Fei, Peng, Hsin-Yuan; Chen, Chao-Jung "A practical home security system via mobile phones", WSEAS Transactions on Communications, v 5, 2006, pp. 1061-1066.

[3] Wayne Wolf, FPGA-Based System Design, Prentice Hall, 2005.

[4] Cho, Joon-Sic, Park, Seon-Ho; Han, Young-Ju; Chung, Tai- Myoung "CAISMS: A context-aware integrated security management system for smart home", 9th International Conference on Advanced Communication Technology,ICACT, 2007, pp. 531-536.

[5] Kim, Eung Soo, Kim, Min Sung, "Design and fabrication of security and home automation system", ICCSA 2006, International Conference omputational Science and Its Applications, Proceedings - Part III, 2006, pp. 31-37.

[6] Fujiyama Hiroyuki, "System-on-a-chip with security modules for network home electric appliances" Fujitsu Scientific and Technical Journal, v 42, n 2 System-on-a-Chip, 2006, pp. 227 233.

[7] Luo Ren C., Hsu Te Y., Lin Tung Y., Su, Kuo L., " The development of intelligent home security robot" Proceedings of the 2005 IEEE International Conference on Mechatronics, ICM '05, 2005, pp. 422-427.

[8] Yang Lili, Yang Shuang-Hua, Yao Fang, "Safety and security of remote monitoring and control of intelligent home environments", Proceedings - IEEE International Conference on Systems, Man and Cybernetics, 2007, p 1149-1153.

[9] Sin-Min Tsai, Po-Ching Yang, Shyi-Shiou Wu, Shya-Shiow Sun, "A Service of Home Security System on IntelligentNetwork", IEEE Transactions on Consumer Electronics, Vol. 44, No. 4, 1998, pp. 1360-1366.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

[10] J.G. Vinson etc., "Secure- Way an Affordable Home Security System". Proceedings, the Institute of Electrical and Electronics Engineers 28th Annual 1994 International Carnahan Conference on Security Technology, IEEE, 1994, pp. 144-146.

[11] Eddie M.C. Wong, "A Phone-Based Remote Controller for Home and Office Automation". IEEE Transactions on Consumer Electronics, Vo1.40, No.1, February 1994, pp. 28-34.

[12] A. Alheraish, "Design and Implementation of Home Automation System," IEEE Transactions on Consumer Electronics, vol. 50, no. 4, Nov. 2004, pp. 1087-1092.

[13] H. Kanma, N. Wakabayashi, R. Kanazawa, H. Ito, "Home Appliance Control System over Bluetooth with a Cellular Phone," IEEE Transactions on Consumer