Design and Implementation of Smart Industrial Automation

Using VHDL onFPGA

[1] Ritwik Roy,[2]Gautam Baid,[3]Satyam, [4]Deepak Kumar

[1]Student, 2nd year B .tech, Electronics & Communication Department, Shivalik College of Engineering, Dehradun

[2] Student, 2nd year B .tech, Electronics & Communication Department, Shivalik College of Engineering, Dehradun

[3] Student, 2nd year B .tech, Electronics & Communication Department, Shivalik College of Engineering, Dehradun

[4]Assitant Professor, Electronics & Communication Department, Shivalik College of Engineering, Dehradun

Abstract

Now-a-days there is an increasing demand of automated control systems in the industry where all the appliances would work automatically according to the environmental conditions and easily controlled by a central control system. This central control system is implemented as FGPA controller by which sensors and devices are interfaced. This control is communicated to user by mobile phone through GSM interface. This results in a simple way, cost effective and most important to enhance the possibility of smart industry.

The review of this paper is to control the machines in industry through GSM instead of Bluetooth automation system, as it suffers drawbacks in controlling range and devices operating. To overcome this problem GSM is implemented in place of Bluetooth because of its smart automation system which will control the equipments smartly for long range.

Index Term

FPGA, Industrial Automation System, GSM, Bluetooth, PLC, VHDL

1. Introduction

The requirements of suitable technology in industries are much essential for automation. The users need technologies which satisfy the requirements of industry in external and internal aesthetics. With the advancements in technology earlier electrical and electronic appliances are more dominant in the industry. However, due to this cost related to electrical consumption increases rapidly according to demand but more efficient in use and rapid production. But,

for small industry this results in high costs and available solutions are not much affordable for them. This will provide a cost-effective solution that uses FGPA controller at the core of the system to provide the intelligence and smart systems.

Moreover, the controller interfaces can control, monitoring, switching of devices through mobile GSM. This allows users to set the office environment according to their needs.

2. Technologies used for automation

Earlier industries use automation by using PLC (Programmable Logic Circuits) or microcontroller. This is not much beneficial for automation in industries due to some drawbacks listed below:-

i. There is too much requirements of connecting wires.
ii. There is difficulty in replacements.
iii. It is much difficult to find out errors when not working properly.
iv. Require skillful workforce.
v. Not easily adjustable in any place.
vi. If some problems occur then time taken for recovery is indefinite.

3. FPGA

It is mainly constituted of Head controller, CMOS sensor controller, Communication controller, PCA algorithm and External Memory controller[Fig 1]. When the input is given to the communication controller that is forwaded to the head controller . Head controller is then decided where to forwarded signal then that signal is forwaded to the respective controller. Lastly signal is reached at communication controller through PCA Algorithm.

3.1 FPGA is beneficial for automobiles

FPGA (Field Programmable Gate Array)[5] is an IC that can be programmed in the field after manufacture. It is similar in principal to any other chips like (PROMs, PLAs, PALs) but here vast potential application. It contains a matrix of reconfigurable gate array logic circuitry that configured in such a way that creates with hardware implementation of software application. In this embedded control system designers are enabled for quickly create and easily adapt FGPA based application. It uses dedicated hardware for processing logic because processing paths are parallel known as CLB(Configurable Logic Block) due to which different operations do not have to compete for the same processing resources. That's why, speeds can be very fast and multiple control loops can be run on a single FPGA has limitless flexibility provided by designer.

Another hardwired such as PCB(Printed Circuit Board) have fixed hardware resources but FGPA system can be rewire their inter circuitry to allow configuration after the control system is developed.

3.2 Uses of FPGA

In manufacturing and automobiles FGPA are well suited for well used in robotics & other machines tool application as well as daily life appliances such as fan, compressor etc,. FGPA are used to reconfigure input and output functionality. Alternatively, same FPGA can reconfigure to perform on digital

signals and measure, pulse width, position, velocity through sensor.

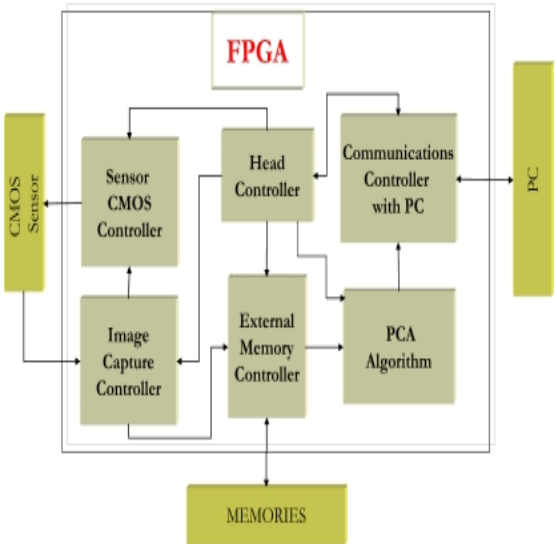

Fig. 1 Block diagram of FPGA

4. VHDL

VHDL is the one of the very high speed integrated circuit hardware description language used to design digital systems from lowest level to highest level (VLSI module). It can also be used as a general purpose parallel programming language. It can describe the behavior and structure of electronic system but in a rigid language i.e. in digital electronic hardware designs such as FPGA's. It allows users to design different perspectives of digital system other than VHDL many HDL are available for digital designers such as Verilog, ABEL, PALASM etc. but VHDL and Verilog are the most widely used HDLs as it will allow fast design and better verification.

The difference observed between HDL and other programming languages is integration of time.

VHDL is a test file describing digital systems, the digital can be represented in different forms like behavioral model or a structural model or a mixed model. Structural modeling in VHDL helps to define the interconnections and components used in them specifically.

Behavioral is used to construct condition statements such as if-else, for loops, while loop etc as used in C-language.

5. ProblemDefinition

The main focus of this paper is to remove the drawbacks which occurs in industry related to controlling range, limited operating of appliances. Now-a-days the advancements of technology will improve gradually. The life style depends on the improvement of the research. All the appliances which are used in our daily life are advanced and based on electrical and electronic equipments. Due to which cost increases but work will be easy and comfortable. This paper will give cost effective solution that used FPGAcontroller at the core of the systems which improve intelligence of the system in automation. This automation process will takes place through GSM communications port to allow monitoring and switching of devices from mobile. This allow users to control the environment condition according to the industrial needs such as temperature etc..

6. Flow of work

Following steps will be followed

(i) HDL will be described a "logic function". The design entry technique will be VHDL. After the design is complete we will verify its functionality using a test bench.

(ii) There will be three stages of simulations i.e. functional simulation, pre layout simulation and post layout simulation.

(iii) It compiles the "logic function" on the computer, using software provided

Description of different component used

- Hardware tools
    1. Xilinx
    2. ALTERA FPGA Development Board
- Software
    1. Xilinx ISE
    2. ALTERA QUARTUS II
- Language in VLSI
    1. Verilog/VHDL

7. Conclusion

Technology advancements have made possible the implementations of automation systems within industries. This has added new capabilities and features, however, most of the time, the implementations are proprietary and networking is not always possible. Yet there is an increasing demand for smart industries, where appliances react automatically to changing environmental conditions and can be easily controlled through one common device. This project presents a possible solution whereby the user controls devices by employing a central FPGA controller to which the devices and sensors are interfaced. Control is communicated to the FPGA from a mobile phone through its Bluetooth interface or GSM interface. This results in a simple, cost effective, and flexible system, making it a good candidate for the future smart industrial solutions.

8. Reference

[1] Carl J. Debono, Kurt Abela, "Implementation of an Automation System Through a Central FPGA Controller",IEEE Conference on FPGA Controllers, YasmineHammamet, pp.641-644, March, 2012.

[2] Nidhi Gaur, Shabarinath B.B, "Design and Implementation of Monitoring System Using RF Technology" International Journal of Advances in Electrical and Electronics Engineering, Vol.1, pp. 59-68,May, 2012.

[3] K. Gill, S.H. Yang, F. Yao, X. Lu, "A ZigBee-based automation system", IEEE Transactions on Consumer Electronics, Vol. 55, no. 2, pp. 422 – 430, May 2009.

[4] N.Sriskanthan, F.Tan, A.Karande,"Bluetooth Based Automation System" IEEE Transactions on Microprocessors and Microsystems, Vol. 26, pp.281 – 289, 2002.

[5] Dr.S. Kishore Redd, K. Manoha, K. Sravani, "FPGA and GSM Implementation of Advanced Security System", International Journal of Engineering Research and Applied Sciences , Vol. 3, Issue 1 ,January, 2013.

[6] Geng Yang, Jian Chen, Tenhunen, H., Li-RongZheng, "Intelligent Electrode Design for Long-term ECG Monitoring at Home: Prototype Design Using FPAA and FPGA", IEEE International Conference on Pervasive Computing Technologies for Healthcare, Minneapolis, pp.2316-2319, September, 2009.

[7] O.Jimenez, O.Lucia Gil, I.UrrizaParroque, L Barragan, D Navarro, V Dinavahi, "Implementation of an FPGA-Based On-Line Hardware-in-the-Loop Emulator Using High-Level Synthesis Tools for Resonant Power Converters Applied to Induction Heating Appliances", IEEE Transactions on Industrial Electronics,Vol.1, Issue- 99, September, 2014. .

[8] L Geng, R.V Penty, I.H White, D.G Cunningham,"FEC-free 50 m 1.5 Gb/s Plastic Optical Fibre Link Using CAP Modulation For Home Networks", 38th IEEE European Conference and Exhibition on Optical Communications ,Amsterdam, pp.1-3, September, 2012.

[9] W.M. El-Medany, M.R El-Sabry, "GSM Based Remote Sensing and Control System Using FPGA", The IEEE International Conference on Computer and Communication Engineering, Kuala Lumpur, pp.1093-1097, May, 2008.

[10] S Sato, Y Okada, T Azuma, "Real Time High-Sensitivity Imaging for Home Surveillance System by Using Combined Long/Short Exposure", IEEE International Conference on Digital Image Computing Techniques and Applications (DICTA), Noosa, pp.429-435, December 2011.

[11] J Acero, D Navarro, L.A Barragan, I Garde, J.I Artigas, J.M. Burdio, "FPGA-Based Power Measuring for Induction Heating Appliances Using Sigma–Delta A/D Conversion", IEEE Transactions on Industrial Electronics,Vol.54, Issue- 4, August, 2007.

[12] N.K. Anish, B Kowshick, S Moorthi, "Ethernet Based Industry Automation Using FPGA", IEEE International Conference on AFRICON, Mauritius, pp.1-5, 9-12 September,2013.

[13] Won-ok Kwon, Hyuk-je Kwon, Kyoung Park, "PCI Express Multi-lane De-Skew Logic Design Using Embedded SERDES FPGA", Proceedings of 7th IEEE International Conference on Solid-State and Integrated Circuits Technology,Vol.3, pp.2035-2038, October, 2004.

[14] Li Qing, Li Wei, Yuan Xin, Xiao Ping, Hu Jingyu, Yang Liangxing, "A TV Graphics Demonstration System Design Using FPGA",2nd IEEE International Conference on Application Specific Integrated Circuits (ASIC), China, pp.1038-1041, October,1996.

[15] P.S Chinchansure, C.V. Kulkarni, "Home automation system based on FPGA and GSM", , IEEE International Conference on Computer Communication and Informatics (ICCCI),Coimbatore, pp.1-5, January, 2014.