International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 56.67 | Impact Factor (2017): 5.156

Fire Detection System Based on FPGA

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Abstract: ***This paper uses modular method to design smoke detection system. On the basis of the requirement analysis, the paper designs and implements all the modules. The smoke detection module is the core of the system, which decides the performance of the system. Using a synergistic manner through software and hardware, the smoke detection module is realized. First of all, using sensors like gas sensor flame sensor and temperature sensor it realizes suspected smoke in area. Finally, the paper builds smoke detect module using Spartan 3A FPGA kit with LCD display. It senses analog data from sensors and notify accordingly.***

Keywords: Smoke Detection, Smoke Dynamic Features, GSM Module, FPGA

1. Introduction

Fire brings a great threat to human life and property security. Fire hazard can be greatly reduced if we can realize early warning of the fire. In order to prevent and reduce fire's crisis to people, human require outstanding fire smoke detection system. Smoke happens before fire and relative to fire flame. So fire can be detected in the initial stage, which is helpful to realize the early warning and control of fire. The FPGA can meet the needs of high speed real time with its hardware features. SOPC technology can make the design flexible, software and hardware in-system programmable and update. This paper designs a fire smoke detection system based on FPGA. The system uses 3A development board of spartan as the hardware platform. When there is fire in the environment, then the system will send the alarming signal and SMS to notify the monitoring staff by GSM module and buzzer.

2. Detection System Design

FPGA-based real-time smoke detection mainly for monitoring smoke in the environment. In the case of fire smoke after monitoring surrounding, the system will generate alarm signals to inform monitoring officer through sound equipment and SMS on his number. Through analysis of system functional requirements, the smoke detection system needs to achieve the following functions: when monitoring the environment of smoke, the alarm signal in real time, and SMS send through GSM Module.

The design of system is made up by software part and hardware part.

3. XILINX andd FPGA

Xilinx, Inc. is the world's largest supplier of programmable logic devices, the inventor of the field programmable gate array (FPGA) and the first semiconductor company with a fables manufacturing model. The programmable logic device market has been led by Xilinx since the late 1990s. Xilinx's sales rose from $560 million in 1996 to almost $2 billion by 2007. The company aims to use the approach to capture greater market share from application-specific integrated circuits (ASICs) and application-specific standard products (ASSPs). Creating a new ISE project for the FPGA device on the Spartan-3A Kit. To create a new project: Select File > New Project, The New Project Wizard appears Creating a VHDL Source ;Create a VHDL source file for the project as follows :Click the New Source button in the New Project Wizard ;Select VHDL Module as the source type ;Type in the file name counter ;Verify that the Add to project checkbox is selected; Click Next; Declare the ports for the counter design by filling in the port information. A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by the customer or designer after manufacturing—hence "field programmable". The FPGA configuration is generally specified using a hardware description language (HDL), similar to that used for an application-specific integrated circuit (ASIC) .The Spartan-3 family builds on the success of the earlier Spartan-IIE family by increasing the amount of logic resources, the capacity of internal RAM, the total number of I/Os, and the overall level of performance as well as by improving clock anagement functions. Because of their exceptionally low cost, Spartan-3A FPGAs are ideally suited to a wide range of consumer electronics applications including broadband access, home networking, display/projection and digital television equipment. The Spartan-3 family is a superior alternative to mask programmed ASICs. FPGAs avoid the high initial cost, the lengthy development cycles, and the inherent inflexibility of conventional ASICs. Also, FPGA programmability per- mits design upgrades in the field with no hardware replacement necessary, an impossibility with ASICs. The Spartan3 family architecture consists of five fundamental programmable functional elements Configurable Logic Blocks (CLBs) contain RAM-based Look-Up Tables (LUTs) to implement logic and storage elements that can be used as flip-flops or latches. Input/output Blocks (IOBs) control the flow of data between the I/O pins and the internal logic of the device. The Spartan®-3 generation of FPGAs includes the Extended Spartan-3A family (Spartan-3A, Spartan-3AN, and Spartan-3A DSP platforms), along with the earlier Spartan3 and Spartan-3E families. These families of Field Programmable Gate Arrays (FPGAs) are specifically designed to meet the needs of high volume, cost-sensitive electronic applications, such as consumer products. The Spartan-3 generation includes 25 devices offering densities ranging from 50,000 to 5 million system gates. The Spartan-3 platform was the industry's first 90 nm FPGA, delivering more functionality and bandwidth per dollar than was previously possible,

setting greater standards in the programmable logic industry. The Spartan-3E platform builds on the success of the earlier Spartan-3 platform by adding higher features that improve system performance and reduce the cost of configuration. The Extended Spartan-3A family builds on the success of the earlier Spartan-3E platform by further enhancing configuration and reducing power to provide the lowest total cost. The Spartan-3AN platform provides the additional benefits of non-volatility and large amounts of on-board user flash. The Spartan-3A DSP platform extends the density range and adds resources often required in digital signal processing (DSP) applications. Because of their exceptionally low cost, Spartan-3 generation FPGAs are ideally suited to a wide range of consumer electronics applications, including broadband access, home networking, display/projection, and digital television equipment. The Spartan-3 generation FPGAs provide a superior alternative to mask-programmed ASICs. FPGAs avoid the high initial cost, the lengthy development cycles, and the inherent inflexibility of conventional ASICs. Also, FPGA programmability permits design upgrades in the field with no hardware replacement necessary, an impossibility with ASICs.

4. Conclusion

This paper designed and realized the fire smoke detection system, realized the real-time smoke detection, smoke moving characteristics with hardware description language programming applying to suspected area with the help of Spartan companies which provide 3A kit V2 development board. By building the SOPC system, we successfully read and process the data. Finally after system debugging and the analysis of the results of operation, the smoke detection system can meet the detection of real-time processing applications.

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