

Implementation of Low Cost IoT based Home Automation system on Spartan FPGA

Dr.P.A.Harsha Vardhini,
Professor, Department of ECE,
VITS, Deshmukhi.

K.Murali Chandra Babu
Asst. Professor, Department of ECE,
VITS, Deshmukhi.

Abstract—Automation has created a bigger hype in the electronics. The major reason for this hype is automation provides greater advantages like accuracy, energy conservation, reliability and moreover the automated systems do not require any attentions. Any one of the requirements stated above demands for the design of an automated device. The energy conservation is very important in the current scenario and should be done to a maximum extent where ever it is possible. In this work design and implementation of home automation system and the design has been described using VHDL and implemented in hardware using FPGA where sensors are interfaced to it. This system uses IoT to establish the communication between network and controller. It also uses wireless technology to improve the standards of living.

Keywords—FPGA, IoT, Home Automation, Sensor.

I. INTRODUCTION

Technology is the collection of techniques, skills, methods and processes used in the accomplishment of objectives. Today's technology is in a stage where we can link up entire physical world with digital world. In order to control this digital world, there are many controllers which receive information from different sensors and process accordingly. The information may be of analog or digital format. A Sensor is an Electronic device which may be of analog or digital based upon its output. In this digitalized world, for any application we have to process the signals received from sensors through digital systems. Due to rapid growth in VLSI field because of high portability and small size, its applications can be used in digital signal processing[1].

Very large scale integration is the process of creating an integrated circuit (IC) by combining thousands of transistors into a single chip. VLSI began in the 1970s when complex semiconductor and communication technologies were being developed. It includes PLD's (Programmable Logic Devices), CPLD's (Programmable Logic Devices), FPGA's (Field Programmable Logic Devices) and ASIC's (Application specific Integrated circuits). FPGA's are more reliable when compared with other VLSI fields. FPGAs contain an array of programmable logic blocks, and a hierarchy of reconfigurable interconnects that allow the blocks to be "wired together", like many logic gates that can be interwired in different configurations. The design is described on VHDL (Programming language) and implemented in hardware using FPGA. There are wide range of aerospace,

defense, medical, industrial applications on FPGA Which includes Image processing, security, home automation etc. Automation has created a bigger hype in the electronics. The major reason for this hype is automation provides greater advantages like accuracy, energy conservation, reliability and moreover the automated systems do not require any attentions. Any one of the requirements stated above demands for the design of an automated device [2]. The energy conservation is very important in the current scenario and should be done to a maximum extent where ever it is possible.

II. LITERATURE SURVEY

Sweatha K N, "International Journal of Advanced Research in Computer and Communication Engineering", proposed "ADVANCE HOME AUTOMATION USING FPGA CONTROLLER", Technology advancements have made the implementation of embedded systems within home appliances. This increased the capabilities and features. There is demand for smart home automation through mobile phones. Bluetooth modules are cost effective and flexible so it is one of the best choices for smart home automation. This paper presents a novel technology where the user controls the devices through mobiles[3]. Implementation is done using FPGA (Field Programmable Gate Array) as a controller to which the devices are directly interfaced. Control to the devices is communicated to the FPGA from the mobile phone using speech recognition technique.

S. D. Sawant, "International Journal of Engineering Research & Technology (IJERT)", proposed "HOME AUTOMATION THROUGH FPGA CONTROLLER". In recent years, the home automation has seen a rapid introduction of network enabled digital technologies. These technologies offer new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation. In this paper, we present the design and implementation of home automation system. The design has been described using VHDL and implemented in hardware using FPGA (Field Programmable Gate Array)[4]. This system uses GSM (Global System for Mobile) network to establish the communication between mobile and controller. The system is SMS (Short Messaging Service) based and uses wireless technology to improve the standards of living.

Azeem Mohammad Abdul, "Journal of engineering and applied sciences", proposed "IOT BASED HOME AUTOMATION USING FPGA", Internet of

things(IoT)had many applications in several domains; it also strides into smart homes[5]. Controlling appliances with IoT can be easily done using smart phone through android apps. Home automation is one of the profound in day-to-day applications. Due to hasty progress in technology, wireless fidelity(Wi-Fi) has brought revolutionary change than compared to wired LAN communication. Existing wireless communication devices such as Bluetooth, ZigBee &and NRF24L01 etc .Are limited to short range. IoT uses Wi-Fi to exchange data wirelessly for large distances using internet. IoT module ESP8266 is used to control the home industrial appliances in remote areas anywhere in the world. Serial Communication exchanges the data between FPGA & IoT module. Home appliances are controlled using FPGA which receives commands in serial communication from IoT module through smart phone app. Compare to existing home automation; IoT based home automation can update device status with email alerts and also in web with IP address which can be password protected. Due to its high precision & smart phone technology helps for physically challenged and senior citizens[6].The above Proposed system carried Home automation on FPGA with GSM and speech recognition system.

The proposed work is a IoT based home automation with a basic Spartan FPGA which is a low cost system with accurate results and high performance.

III. IOT BASED HOME AUTOMATION ON FPGA

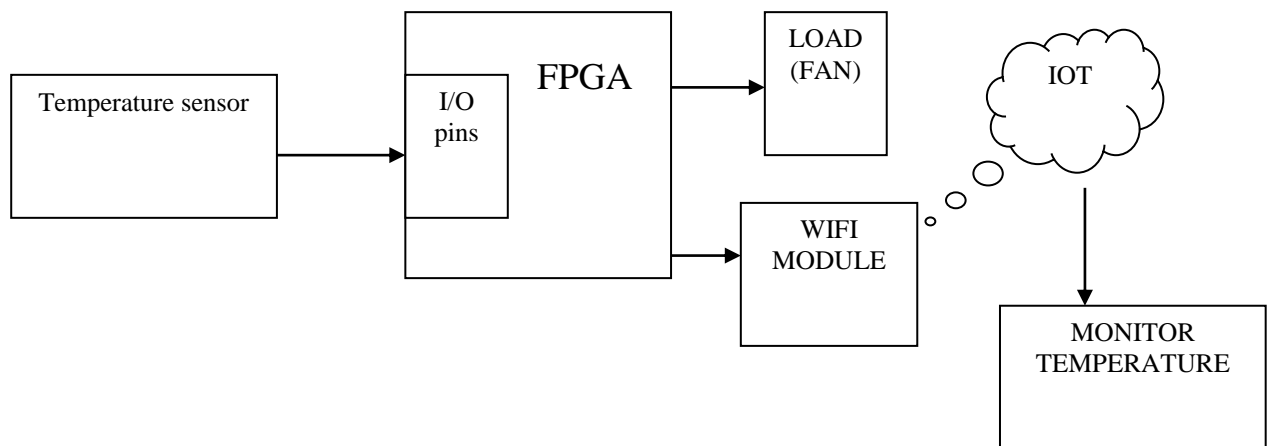


Fig.1. IoT Based Home Automation on FPGA

This paper presents a cost-effective solution that uses a Field Programmable Gate Array (FPGA) controller at the core of the system to provide the intelligence for the home system. IoT or internet of things is an upcoming technology that allows us to control hardware devices through the internet. Here we propose to use IOT in order to control home appliances, thus automating modern homes through the internet.

The architecture of the system mainly consists of three main components as shown in Figure, the controller, and the remote devices and sensors. The controller connected to the different types of sensors and devices. An interface

FPGA finds several applications in various fields like Signal processing, Radar applications, Military, Bio medical, Industrial Automation etc. Here we are designing a system which controls entire home appliances remotely and provides security, when the user is away from the place.

This system provides ideal solution to the problems faced by home owners in daily life. The motivation is to facilitate the users having universal access to automate their homes. The home automation system provides availability to develop a low cost solution which is affordable and allows home security. The ease of deployment is due to wireless mode of communication. To realize the home automation networks, many sensor devices need to be deployed in the house to collect various real-time information of the home environment such as temperature, humidity, light and motion, etc. The users who get these data can then know what happens in their homes and may take some actions to control the home appliances, such as turn off the light that is still on in the room or turn on the air conditioner.

The system is capable enough to give feed back to user about the condition of the home appliance according to the user's needs and requirements. This system provides ideal solution to the problems faced by home owners in daily life[7].

circuit has been designed which includes sensors as input devices and a 5v DC motor as an output devices which represents the controlled devices. The controller consists mainly from three components: The Control Unit (CU), ROM, and UART (Universal Asynchronous Receiver Transmitter). The VHDL code also includes a communications[8].

The UART receiver converts the serial stream of received bits into parallel data to be recognized by the control unit. The ROM stores the user telephone number, AT commands, and ASCII code characters. In case of remote sensing the chip will receive signals from the

different sensors in the monitoring place and acts according to the received signal by controlling the devices at the remote place, for example turning on the AC before returning home. The system can work as a Remote Sensing for the electrical appliances at home to check whether it is on or off, at the same time the user can control the electrical appliances at home. It also works as automatic and immediate reporting to the user in case of emergency for home security, as well as immediate and automatic reporting to the fire brigade and police station according to activated sensor to decrease the time required for taking action.

A. FPGA

There are many advanced versions in FPGA board. Spartan 3A is used in this work. This board consists of 36 i/o pins, one ADC and DAC, inbuilt temperature sensor, one power supply port, a port for serial communication and a slot for LCD display. The VHDL code to be dumped in to the board for processing. Since the board is a digital processing unit, the output from analog sensors are converted in to digital format and applied to FPGA.



Fig.2. FPGA3AN

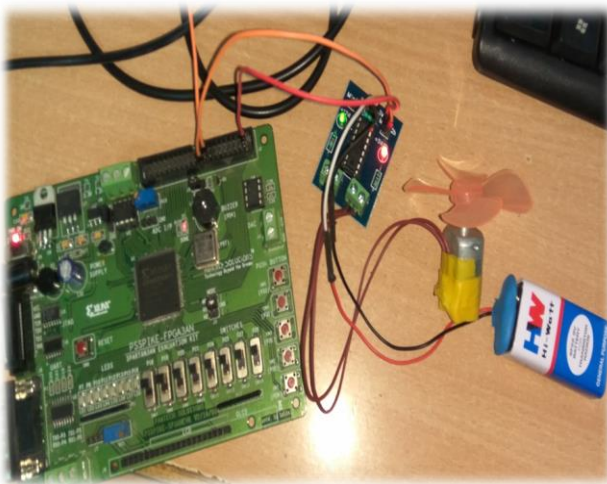


Fig.3. FPGA Interfaced with components

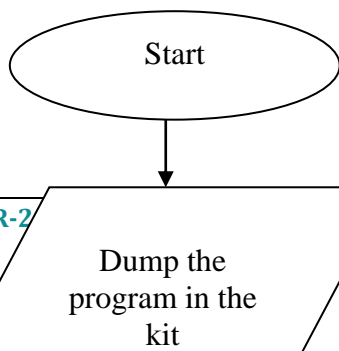


Fig.4. Flow Chart

The output of FPGA is given to the motor driver, through motor driver it is given to a dc motor. When ever the sensor senses that the temperature is greater than threshold, FPGA board sends Logic 1 other wise it sends logic 0.

Hardware Implementation:

FPGA Development board inbuilt consists of LM35(Temperature) sensor which detects the temperature

of surroundings, if it exceeds the mentioned threshold value output is given to the motor. If the temperature is greater than threshold value then the logic 1 will be generated and the fan will turn on, where as when the temperature is less than threshold value than the logic 0 will be generated.

The main aim of this work is to control entire home appliances using a FPGA controller and linking up with IoT.

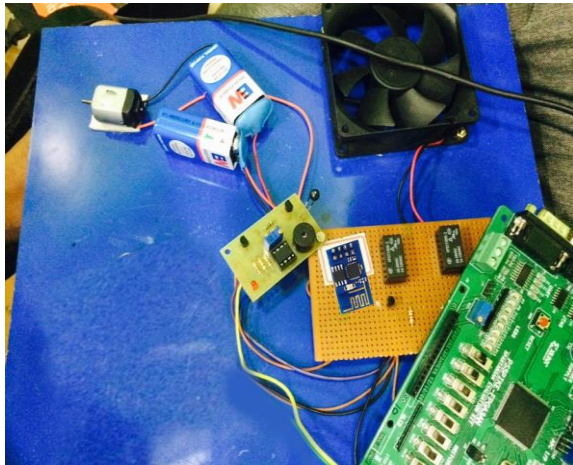


Fig.5. Devices interfacing to FPGA

Proposed system control a fan based upon the temperature recorded by the sensor and it is updated in the webpage through wifi module. This can be further extended by connecting numerous sensors with which we can automate entire industry.

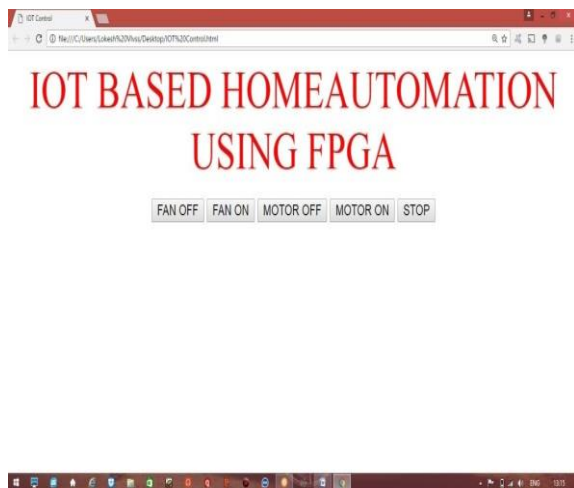


Fig.6. Webpage screenshot

IV. CONCLUSION

A low cost control system using FPGA for home automation is developed. 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 3A FPGA. The design was simulated and verified for the working operation of the whole system.

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