

Automated and Secured Smart Home through FPGA Controller

Nikhath Parvin, Pramod Kumar Jain, Devendra Singh Ajnar

Abstract: Now a days everything is becoming smart due to the upgradation of the technology like smart phones, digital watches, smart city etc., the home automation has become most popular. The smart home is also the part of modern lifestyle. It does make our life more comfortable and easy as well as secured. Also took a look towards security system of home using various sensors buzzers. In this project I would like to work over automated house and the security system of the home. Now a days crime level get increase so I took a glance over it, first of all I have worked on VHDL (hardware descriptive language) and I have code for various sensors like temperature, fire, PIR, and gas sensor and after that I have burn my program into compatible FPGA on the xilinx14.7 and according the requirement of the ports (I/O). then worked over the mentor graphics to generate there layout of the corresponding design using (.vhd) file.

Keywords: FPGA, sensors, VHDL

I. INTRODUCTION

The home automation system upgrade the life style of the people. In big cities life is so fast people don't have time to do so many basic things. The smart home project gives comfort and easiness into the life style. In our project I have worked over VHDL for the coding of the sensors and cadence for making layout of our described design of the smart home. I have created security system by using this automated house. I have used PIR sensor, temperature sensor (LM35), Gas sensor, Fire sensor, buzzers, motor relays etc. The security is major concern to design this project. In this project I am using FPGA on the place of the microcontroller because FPGA provide more speed faster than microcontroller. In this project I am performing smart home as well as secured home using (FSM) concept.

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II. BLOCK DIAGRAM

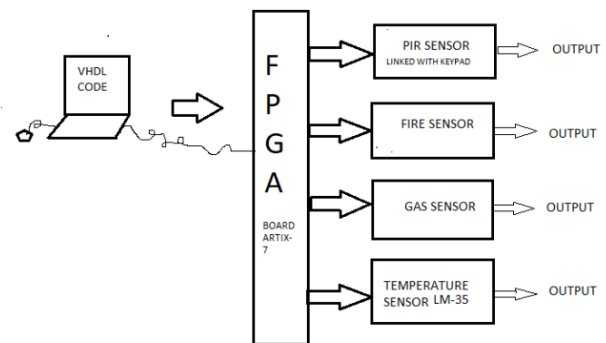


Figure1 Block diagram of the smart home

A. Block Diagram For Door

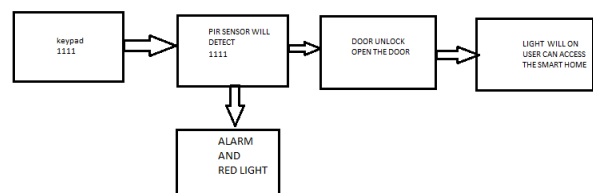


Figure2 Block Diagram For Door

B. Working Of The Block Diagram

- When anyone enters into the smart home without entering the code then PIR sensor will detect then the alarm will be turned-ON and a light will glow that will be a red light.
- If anyone press the correct on keypad then PIR sensor will detect then it corresponding door will unlock and the person can enter into the home. And the light will get ON.
- If somewhere flame get ignite then fire sensor will detect it and corresponding buzzer will start buzzing & red light will glow.
- If some where smoke or LPG gas will get licked then the gas sensor will get sense it and the smoke alarm will be get ON and a red light will glow.
- The alarm can be turned off by the button of keypad.
- These can count the person entering and exiting by the sensor at door.

III. OBJECTIVE

The main objective here is to construct a mechanism using FPGA controlling unit for automated and secured home. We are using the FPGA instead of micro controller for the purpose of connecting various devices in order to monitor them &

indeed an FPGA is the best option to be used as a controller and a processor. The devices linked with the FPGA are the DC motor, stepper motor, sensors like LM35, PIR sensor, gas sensor, fire sensor and an LED. The layout has been explained through VHDL & executed in hardware using FPGA (Field Programmable Gate Array). This mechanism applies analog to digital conversion process to change the analog data obtained by the sensor and transform it into digital. These technology enhance the standard of living.

IV. MODULES USED

A. GAS SENSOR

A gas sensor is used to identify the existence of a possible LPG leakage in your home, these detect gas into closed storage or in the environment. This sensor can be easily integrated with an alarming device or a buzzer, to produce sound at the time of gas leak. The alarm will give a visual evidence of the LPG concentration. The sensor shows a quick and appreciable reaction time. The sensor can also identify iso-butane, propane, LNG and cigarette smoke and any other kind of toxic gas.

Applications

1. To detect gas leak.
2. To detect fire.
3. It is used into gas leak buzzer.
4. To detect toxic gases.

Features

1. It provides high sensitivity.
2. Sensing range: 100-10000 ppm.
3. Fast response time: 10.0sec.
4. Heater voltage: 5 volts.
5. Dimensions – 18mm diameter 17mm high.
6. Excluding pins i.e. 6mm high.



Figure.A gas sensor

B. PIR SENSOR

A passive infrared sensor is an electronic sensor which determines infrared light emitting from objects in its field of view. Use of these sensors can be seen in PIR-based motion detectors very often. Due to the wiring used its time efficient in nature as well as possess a sensitivity that can be adjusted and output LED indicator. Everything with a temperature above absolute zero emit heat energy in the form of radiation. Generally this radiation is not visible to the human eyes because of the nature of the wavelength but it can be identified by electronic devices made for such purpose. Here passive in this context refers to the fact that PIR devices don't produce or emit any energy for detection purposes. They work totally on the basis of detection of energy radiated by other objects.

PIR sensors don't identify or measure "heat", instead they identify the infrared radiation released or reflected from an object.[2]



Figure.B sensor

C. FIRE SENSOR

A flame detector is a sensor constructed to identify and react to the presence of fire, resulting in flame detection. Identification of flame depends on how the installation is been done and can include a sounding alarm too resulting in deactivation of fuel line (such as a propane or a natural gas line) and activation of a fire suppression system. It can be applied at industrial furnaces and similar places where there are chances of a possible fire threat, the sensor's role is to assure that the places where it is used are working properly and in such cases they take no direct action other than just notifying the operator or control system. A flame detector has potential and can often react faster and more precisely than a smoke or heat detector because of the mechanism used to detect the flame.

D. TEMPERATURE SENSOR

Here we are using LM35 as temperature sensor because the LM35 series are accurate integrated-circuit temperature sensors, whose output voltage is linearly corresponding to the Celsius temperature.[2] The LM35 is a unified circuit temperature sensor LM35 to quantify temperature. We can measure temperature more precisely by this rather than using a thermistor. It doesn't provide self heating. The sensor wiring is isolated and not exposed for oxidation. The LM35 creates a higher output voltage (4-20) as compared to thermocouples & may not require to amplify the O/P voltage further

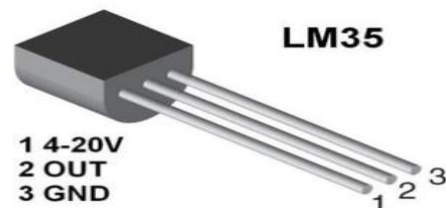


Figure. D temperature sensor

V. MAKING OF THE PROJECT

The code for sensors is written in VHDL(hardware descriptive language) and the RTL will be get generate that code will called RTL .and a schematic will get generate that will be our actual RTL. I have worked Xilinx 14.7 then the test bench code, I wrote the code into the same Xilinx 14.7 then simulation will take place by using XILINX ISE simulator. Then by using UCF file of FPGA WE will generate a binary code that generated binary code is burnt on FPGA

Artix-7.and layout is made into cadence (back end tool).to generate tb waveform the code is wrote into Xilinx 14.7.and simulation is done by ISE SIMULATOR of Xilinx.

VI. RTL OF THE AUTOMATED HOUSE

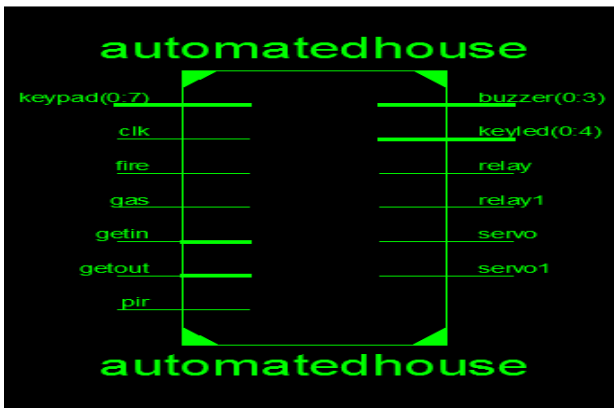


Figure.3 RTLschematic

VII. SCHEMATIC OBTAINED FROM XILINX 14.7

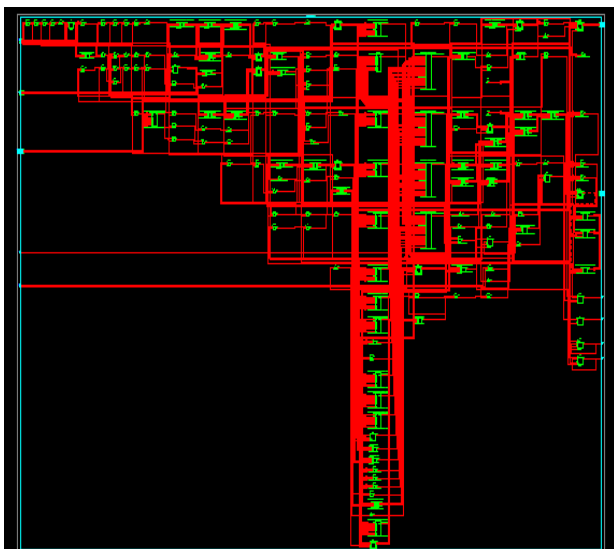


Figure.4 automated house obtain from xilinx

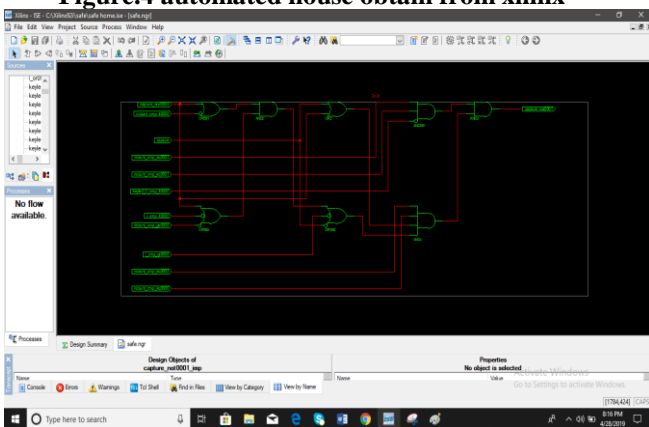


Figure.4(a) extended RTL

VIII. SIMULATION AND FINAL RESULT WAVEFORM

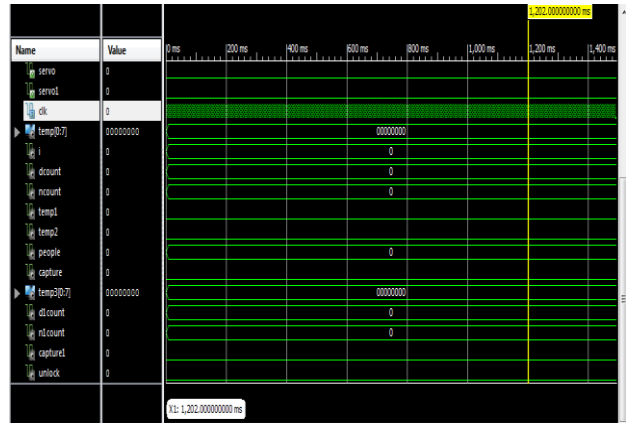


Figure.5 when we don't apply any input the waveform will be

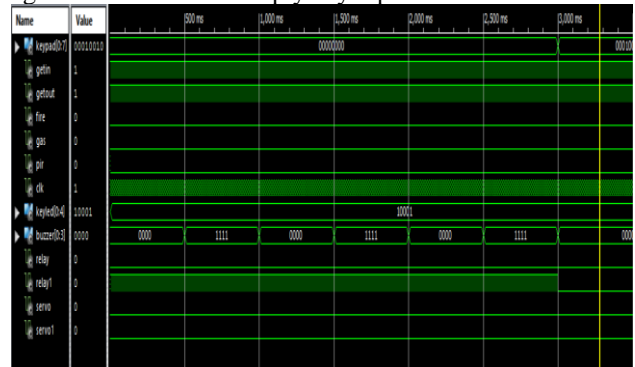


Figure (5.1)

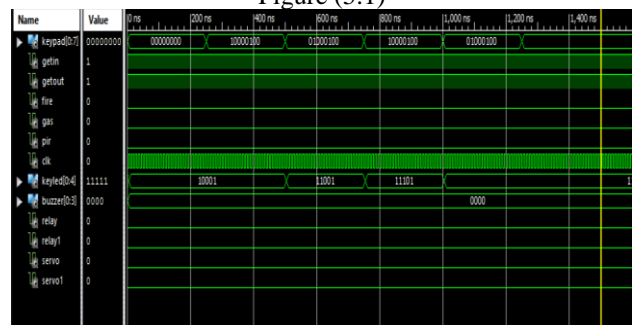


Figure (5.2)

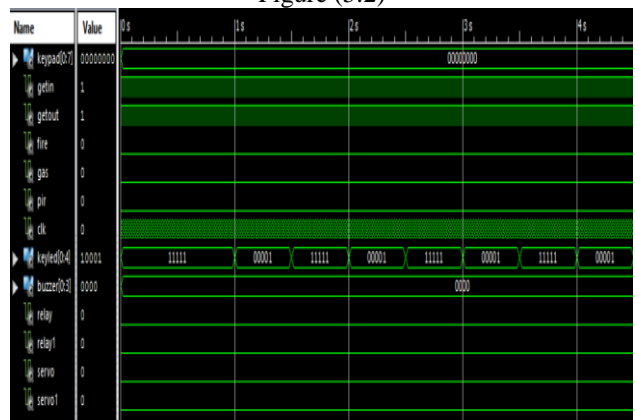


Figure (5.3)When we do variations then output will be like

IX. DESIGN SUMMARY

automatedhouse Project Status (06/29/2019 - 17:59:22)			
Project File:	auto.xise	Parser Errors:	No Errors
Module Name:	automatedhouse	Implementation State:	Programming File Generated
Target Device:	xc7a100t-3csg324	• Errors:	No Errors
Product Version:	ISE 14.7	• Warnings:	No Warnings
Design Goal:	Balanced	• Routing Results:	All Signals Completely Routed
Design Strategy:	Xilinx Default (unlocked)	• Timing Constraints:	All Constraints Met
Environment:	System Settings	• Final Timing Score:	0 (Timing Report)

Figure.6 design summary

X. COMPARATIVCE ANALYSIS TABLE

SR NO.	YEAR	WORK	ADVANTAGES	DISADVANTAGES
1.	2001	Bluetooth based Home automation	Wireless technology. Low cost. RF band	Slower response. Complex design. Large hardware
2.	2002	Microprocessor based Homeautomation	Better Design. Less Expense. High Speed	Large programming. Multiple IC's
3.	2008	Network Monitoring	Wireless communication. Easy Accessibility	Easily hackable. Less feature
4.	2010	Cloud server	Higher speed. Wide range	Maintenance of cloud. Continuous internet connection required.
5.	2013	High FEATURE (FPGA)	Reprogrammable gates. High speed response. Secured Features.	Design specific. High cost. Bits Required

XI. PICTURE OF FPGA ARTIX-7

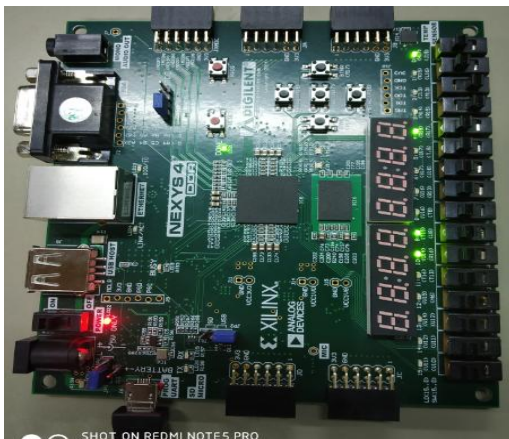


Figure .7 obtained after burning program into FPGA

XII. RTL USING MENTOR GRAPHICS

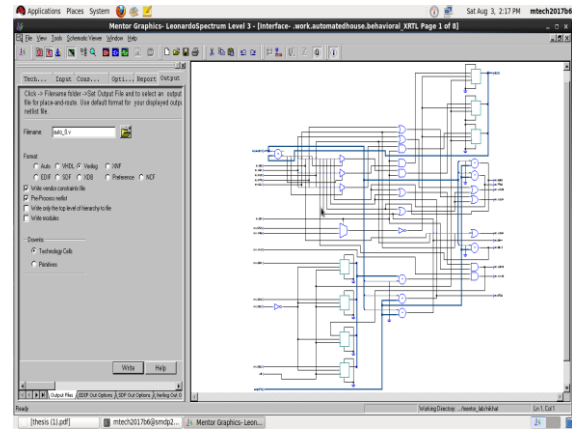


Figure.8 RTL obtained from mentor graphics

XIII. LAYOUTU USING MENTOR GRAPHICS

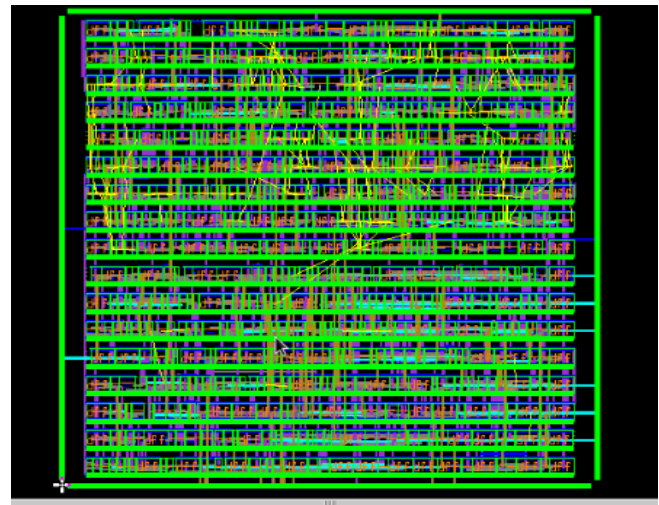


Figure .9 layout by mentot graphics

XIV. ADVANTAGES

- Increases Security and Privacy.
- Maximizing home security by using Automated Door Locking system
- Pre Alerts people from fire digester.
- It is time Saveing.
- Adds Safety through Appliance and Lighting.
- It dose Improve appliance efficiency and life time
- Increased energy efficiency.
- Provides Money security and Increases Convenience.

XV. APPLCATIONS

- Security of valuable things like cash, documents, Jewelry, etc.
- Access to restricted places or for authorized People.
- Digitally locking and unlocking system.
- Protection from theft incidents and alarm
- Mechanism.
- Fire protection and alarm.



- Gas detection and notification.
- Security: a security system equipped with a home automation system can provide the luxury of some additional features such as remote surveillance of security cameras using internet or central
- Locking of all premises, doors and any other source of entry or exit.

XVI. CONCLUSION

In this project we have amalgamated sensors with FPGA like gas, PIR, fire sensors and various buzzers. PIR sensor operates the opening of the door. It is also accountable for supervising the motion. Administer the temperature and it controls the AC. The gas sensor gives the information about Toxic gas. And the fire sense gives information about fire and prevent us from hazardous fire.

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