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FPGA BASED WIRELESS ELECTRONIC SECURITY SYSTEM WITH SENSOR INTERFACE THROUGH GSM

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ABSTRACT

The advanced improvement of current technology innovation and Cell phone, keen method for living has ended up being a noteworthy part in the present period of human life. Tremendous growth in wireless communication has enabled the researchers to use wireless portable personal devices such as Wi-Fi-UART, ESP8266 (IOT), Bluetooth, ZigBee, GSM, GPRS, data card and other wireless sensor networks to append with custom applications to control remote appliances. In this paper we propose a wireless electronic security system with touch sensor interface through GSM. It is applicable to banks, schools, colleges, home and industrial appliances. Home mechanization, which is controlled by utilizing Android advanced cell. The home apparatuses that have to control is associated with relays connected with GPIO ports of the FPGA board which are activated and deactivated through commands in serial communication (UART) from cell. Status of the appliances sent via SMS through GSM SIM 900A module to a predefined numbers programmed in system. The primary target of home computerization is to help impeded and old matured individuals that will empower them to control home apparatuses and caution them in some quick circumstances accordingly. Design is synthesized on Xilinx Platform Studio (XPS)-Embedded Development Kit (EDK) and implemented on Spartan-3E FPGA.
Keywords: *GSM, FPGA, XPS-EDK Touch Sensors, Relays.*

1. INTRODUCTION

The Tremendous growth and innovation in present day wired and wireless technologies, humans are more erected to innovations in wireless technologies which became a part in the present period of human life. Few examples technology advancements are wireless printing, Bluetooth based call answering, automatic door opening and close by face detection by wireless camera etc.., advanced features has changed the human life style more secure with reduced physical presence. Communication means sharing information from one point to another point. It can be done in mainly two ways, wired and wireless communication. Wireless communication plays a dominant role in present scenario because of its high security and easy accessibility [1]. GSM technology dominates Bluetooth, ZigBee, NRF24L01 etc., technology, because it is limited to certain area [2]. GSM can be accessed throughout the country. Now present Bluetooth ZigBee Technology can be accessed only in terms of meters, but GSM technology can be accessed throughout the state by means of GSM modules (SIM900A) which are very cheap in the market. GSM/GPRS/GPS is the upcoming trend and future will depends on this to control remote appliances. There are number of potable wireless modules available in the market, but compared to them GSM modules are more reliable and cheap for using as Home and Industrial security applications compared with distance and network point of view [3], [4]. FPGA based electronic security system with sensor interface through GSM can be achieved by monitoring Status of the appliances sent via SMS through GSM SIM 900A module and controlling the home appliances. [5] Control is associated with relays connected with GPIO ports of the FPGA board which are activated and deactivated through commands in serial communication (UART). In the coming sections we discussed about EDK Design Flow of Xilinx in

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section 2, section 3 describes about peripheral devices interface to FPGA, section 4 examines about the Design Methodology, Section 5 demonstrates the Simulation Results of our task, and section 6 manages the Physical Implementation on Spartan-3E FPGA.

2. EDK DESIGN FLOW USING XILINX PLATFORM STUDIO

Xilinx created Xilinx Integrated Software Environment (ISE) which is utilized to produce net records. Hardware Description Language (HDL) plans, which are investigated empower the engineer to assemble client outlines, take a outlook at charts of schematic figures, concentrate on timing examination, recreation of created plan and focus on gadget with the originator .Xilinx ISE is therefore utilized for producing net records and outline. Xilinx likewise contains different instruments, for example, EDK (*Embedded development kit*), SDK (*Software Development Kit*).

2.1 EDK (Embedded Development Kit):

EDK gives an arrangement of outline devices that happen to be founded on a common structure which allow to plan a far reaching framework for the execution in Xilinx.
It comprises of XPS (*Xilinx Platform Studio*).
•ESTs (*Embedded System Tools suite*).
•SDK (*Software Development Kit*)

SDK is utilized in the creation of programming application in embedded. EDK has various often utilized portions where a few assortments of frameworks could be made by utilizing these sorts off fragments. To make each of our own fragments EDK utilizes IPIF (*Intellectual property interface*) so as to operate comparative usefulness between different operator sections. EDK additionally provides user the IP Interconnect transport conventions which are just utilized rather on the subject of Processor Local Bus (PLB) transport convention specifically. Utilizing this IPIF module with suited details coordinates our necessities which lessen outline and test exertion by tremendous sum.

Xilinx platform studio utilized by BSB (*Base System Builder*) for delivering a straight forward processor framework which thusly may utilize desired portion. Equipment Description Language layouts could be delivered by utilizing make and import (make mode) portion wizard. In order to open .npl record that delivered in make mode venture pilot is used. Likewise add additional example to the fragment top layout record to execute our custom operation in client logic.vhd document. Plan connected with translate, map, place and course. Taking after executes the configuration .bit record which are to be submitted are frequently downloaded to the FPGA board.

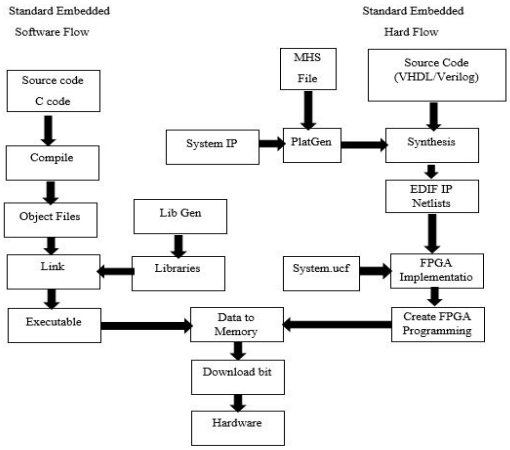

Figure 1: Edk Design Flow

2.2 XPS (Xilinx Platform Studio):

XPS presents a layout for producing both programming and equipment particular moves for embedded frameworks. XPS gives an editorial manager and an undertaking administration interface to make and alter source code, gives change of hardware stream development alternatives, besides offers a graphical framework administrator for the association of operators, ancillaries, and transports. It can incorporate and alter centre variables. They have the capacity so as to produce and change the Microprocessor Software Specification (MSS) document that gives a capacity to make and view a framework square chart. It encourages different client programming program advantages to extend administration.

2.3 SDK (Software Development Kit):

SDK is a related GUI to (XPS) and offers an improvement with a specific end goal to operate

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program ventures. It provides application assemble arrangement notwithstanding customized make record innovation. Navigation error is their unique element. An SDK for an operating system add-on may include the add-on software itself, to be used for development purposes if not necessarily for redistribution together with the developed product.

3. I/O PERIPHERAL DEVICES:

3.1 GSM Module:

GSM SIM900A module shown in figure 2 is used to send and receive sms. Module is interfaced with FPGA through RS232 serial communication. When VSMAS inputs to FPGA, GSM module automatically sends SMS to a phone numbers recorded in a program using Xilinx EDK [1].

Figure.2 Gsm Sim900a

3.2. Touch Sensors:

A touch sensor takes a shot at the straightforward direction based instrument which had a switch or catch. At the point when the catch detects a finger touch or the catch squeezing the circuit inside the sensor associates and the Drove sparkles inside it shown in figure 3.

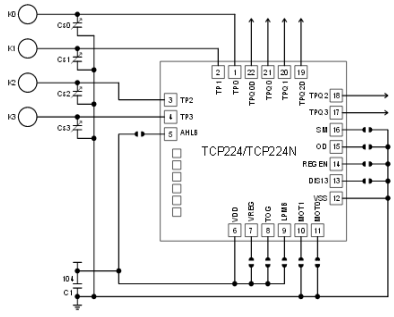

Figure.3 Four Input Touch Sensor

In this application we utilize a 4way computerized touch sensor to our solace that at least to amplify the likelihood of working of the sensor legitimately. Sensors placed at the corners of the electric appliance [6].

3.3. Relays:

Relays are an electrical gadget, commonly joining an electromagnet, which is initiated by a present or flag in one circuit to open or close another circuit shown in figure 4. Relays are generally used as remote sensing devices which are commonly called used as remotes in our general life purpose which are mostly used in electronic circuits, telephone switching networks home and industrial applications etc to relays to activate and deactivate the appliances with minimum voltage signal as trigger input.

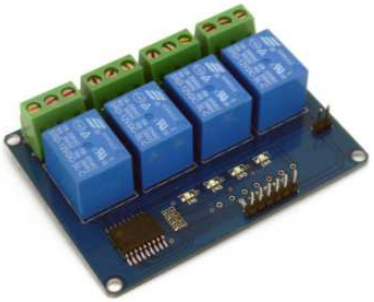

Figure.4 Four Channel 12v Relays

3.4. UART:

Universal Asynchronous Receiver Transmitter receives and transmits data in serial to parallel and parallel to serial with different Baud Rates per second, with start stop and parity bits. FPGA board consists of limited I/O's N-Bit operations can be performed through RS-232 serial communication [3]. UART shown in figure 5.

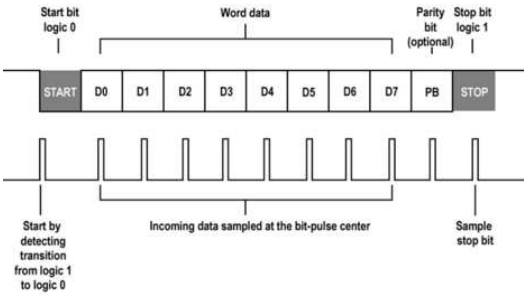

Figure.5 UART

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4. DESIGN METODOLOGY

In this paper we propose a home automation framework which is controlled utilizing a mobile phone for custom applications. MicroBlaze Soft core Processor configured in Spartan3E FPGA using Xilinx Platform Studio-Embedded Development Kit to control the home appliances which are associated with relays connected to GPIO ports of FPGA through UART (RS232). The correspondence between the GSM module and the mobile phone is remote and afterward that module is serially communicated with the FPGA board through RS-232 protocol for the control of home appliances. The general engineering of the framework is appeared in figure 6:

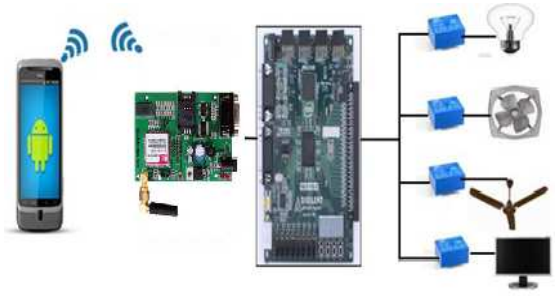

Figure 6: Block Diagram

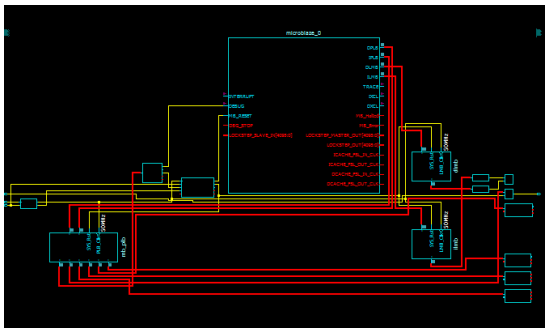

Figure 7: Xps Generated Block Diagram

Xilinx Platform Studio- Embedded Development Kit tool generated block diagram shown in figure 7. Receiving commands from UART Receiver results shown in figure 8. Sending commands from UART transmitter results shown in figure 9. Graphical representation of resources utilized for the task in Spartan-3E FPGA architecture shown in below figure10 and table 1.

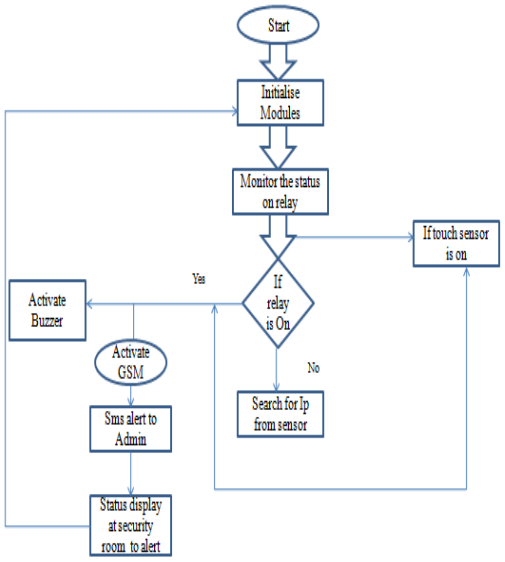

Figure 11: Flow Chart

The flowchart operation of algorithm is shown in below figure 11. Initialize the modules, user can send command "s" to know status of application. Then application running on FPGA responses the current status of application by providing reply sms to user no. of relays on and off. If any touch sensor is activated siren rings to alert security also sms was send to administrator mobile number programmed in FPGA regarding electronic theft information. Ensure that the GSM module is operated at 12V DC and touch sensor module and FPGA are supplied with 3.3V DC to make the security application working in an active mode.

5. SIMULATION RESULTS

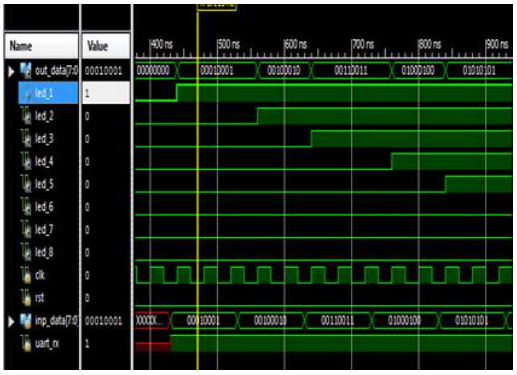

Figure 8: Receiver Results Of UART

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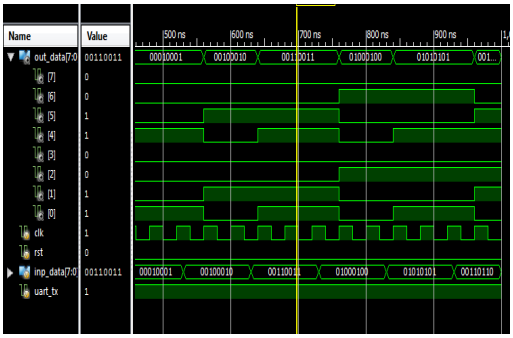

Figure 9: Transmitter Results Of UART

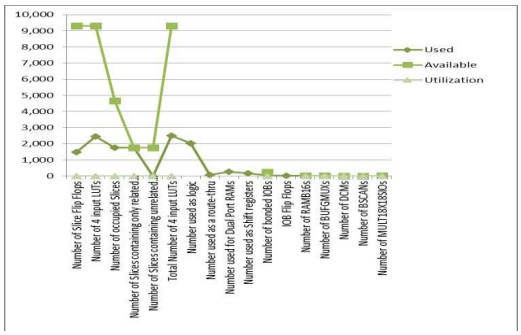

Fig 10: Graphical Representation Of DUS

Table.1 Resource Utilization Summary

Device Utilization Summary [D U S]			
Logic Utilization	**Used**	**Available**	**Utilization**
Number of Slice Flip Flops	1,475	9,312	15%
Number of 4 input LUTs	2,447	9,312	26%
Number of occupied Slices	1,761	4,656	37%
Number of Slices containing only related logic	1,761	1,761	100%
Number of Slices containing unrelated logic	0	1,761	0%
Total Number of 4 input LUTs	2,506	9,312	26%
Number used as logic	2,032		
Number used as a route-thru	59		
Number used for Dual Port RAMs	256		
Number used as Shift registers	159		
Number of bonded IOBs	35	232	15%
IOB Flip Flops	22		
Number of RAMB16s	16	20	80%
Number of BUFGMUXs	2	24	8%
Number of DCMs	1	4	25%
Number of BSCANs	1	1	100%
Number of MULT18X18SIOs	3	20	15%

The below figure 12 shows Touch Sensor Interface to FPGA, Touch Sensor Activated indicates that the sensing of the touch sensors to the fingers prints thus shown in figure 13. Application sends SMS to the registered number which is input in the program shown in figure 14.

6. PHYSICAL IMPLEMENTATION

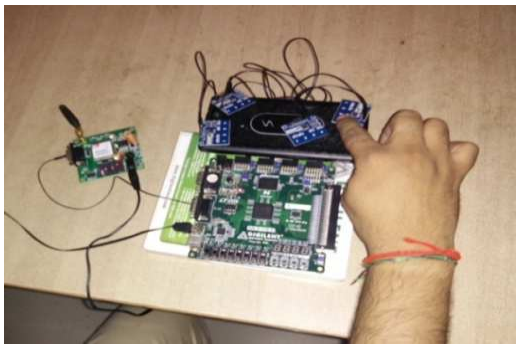

Figure 12 Touch Sensor Interface To FPGA

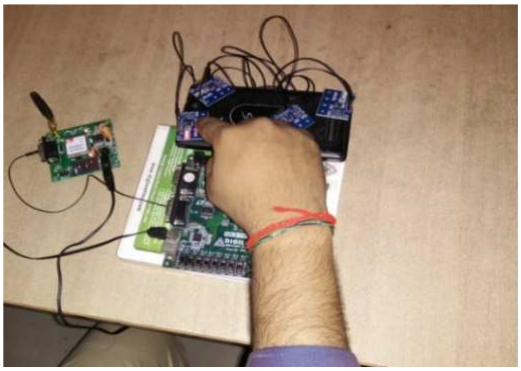

Figure 13 Touch Sensor Activated

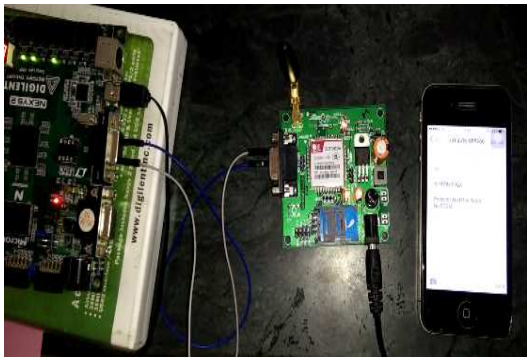

Figure 14 Automatic SMS To User When Sensors Activated

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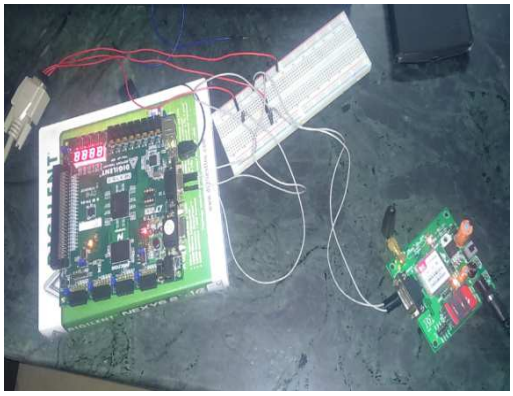

Figure 15 User Giving Commands To Application

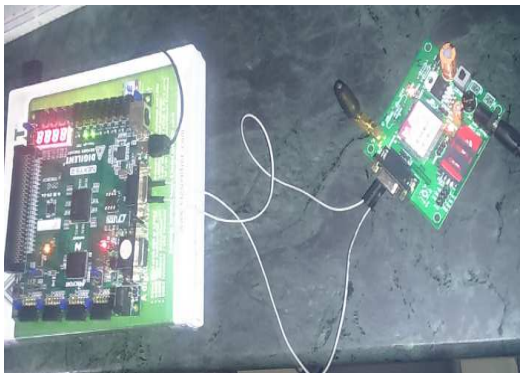

Figure 16 Application Responds To Commands Given By User

Figure 17 Relays Are Activated Controlling The Appliances From Supply Mains.

User can send commands to FPGA through GSM shown in figure 15. Application executing on FPGA responds to commands on RS-232 which activates the relays shown in figure 16. Home appliances are controlled through Relays which are connected to supply mains shown in figure 17 responds to commands given from user controlling the relays through inbuilt soft-core MicroBlaze Processor.

CONCLUSION:

In this work an ease, secure, remotely moreover as firmly controlled for Computerization of homes apparatuses had been designed. This configuration is had accomplished the objective of prevailing home appliances and industrial machines through GSM SIM 900A with wireless technology innovation. Moreover the security application can be extended for illiterates rather than text sms an automatic photo capture of current scene was sent to a register user by multimedia message automatically through GSM module, wireless spy camera interfaced to FPGA.

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