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Implementation of Home Automation on Spartan FPGA Board using Bluetooth

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Abstract:

With the use of modern technology and Smartphone the way of living has changed in the present era of human life. For convenience and controllability within the short range the Bluetooth technology is necessary platform. In this project a Bluetooth Module (HC-05) is used for Home automation. A Blue tooth module is connected to a Spartan-6 FPGA device and the three parameters such as motion, temperature and intensity of light are controlled by using Android Smart Phone via Bluetooth. The FPGA board was connected with the relays which are controlled by programming FPGA using VHDL. The objective of this project is to help handicapped and old aged people.

Keywords : Home Automation , FPGA, Bluetooth, VHDL.

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I. INTRODUCTION

A low cost solution for home automation system which can be easily deployed by wireless mode of communication. Many sensors are used to deploy for the home automation networks to collect various real-time information of the home environment such as temperature, light and motion, etc. The controlling and monitoring of the devices is made by using Spartan -6 FPGA board. The Bluetooth wireless technology is used for home automation in a cost-effective manner. In this project a Bluetooth Module (HC-05) of operating frequency 2.4 GHz is used for Home automation, it can link digital devices within a range of 10 m. The FPGA interfaces to a mobile device through mobile application to allow monitoring and controlling of the devices. This system can be used anywhere, as long as it in the range of Bluetooth is available. With the use of technology the life is becoming more comfortable and easy.

II. LITERATURE SURVEY

Many papers have referred for this project. The paper title "Home Automation through FPGA controller" [1]. In this paper, we present the design and implementation of home automation system. The design has been described using Verilog and implemented in hardware using FPGA (Field Programmable Gate Array). Another paper title" "Implementation of Smart Home Automation System on FPGA Board Using IoT"[2]. Intelligence based on microprocessors is used by home automation to incorporate electronic structures in the household. The inducement in arrears' home mechanization is economical application of electrical energy. Thus, a spread of analysis and lots of resolutions on home automation has been planned. These structures use laptop, mobile web, GSM Bluetooth, and Zigbee network, etc. The paper title" Implementation of Low Cost IoT based Home Automation system on Spartan FPGA"[3]. 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

III System Design

The main motive of this project is to control the home appliances using android application through Bluetooth module. FPGA controller program is developed to make the automation of home appliances in VHDL. In this work three parameters are considered mainly motion, temperature and light and depending on level a particular action will be initiated. If temperature level is low then the fan will be turned off or vice versa action will be taken. In motion sensor, according to movement of human action will be taken.

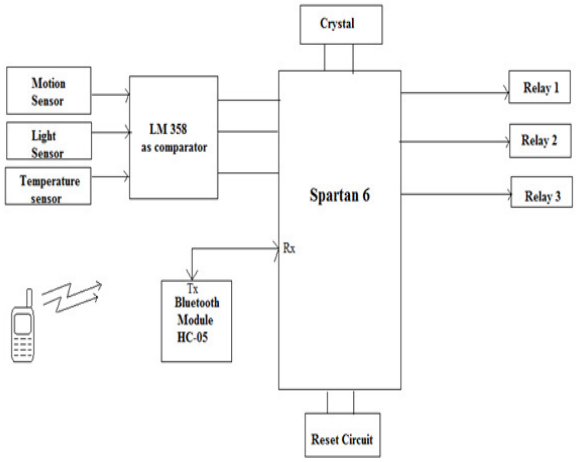
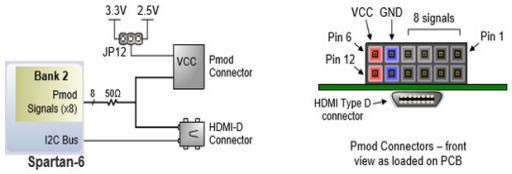


Figure.1. Basic block diagram of system design

Initially there is need to install the "Bluetooth terminal" application in our android mobile and then switch ON the Bluetooth in our mobile, make sure that the Bluetooth is in ON condition or not. If it is not ON then turn it ON. Once the Bluetooth is turned ON give power supply to the HC-05 Bluetooth module and pair it with the android mobile via Bluetooth. Pairing between these devices is done by typing the secured password which is set by us. Make sure that the module is in given range as all the controls works only if the Bluetooth module is in our range. This Bluetooth module has another option of connecting to the last paired device directly i.e. if the device is already paired and got disconnected it can get paired automatically as it is already stored in phone memory. This is the flexibility that is available with this Bluetooth module.

If the Bluetooth module is paired then connect the FPGA and HC-05. For connecting HC-05 module we have used pin configuration such as Receiver pin(V4), GND(R3), VCC(T4) from Pmod connector of FPGA Board. Now, configure application bit file in target FPGA and then give the instruction. This instruction given to control the appliances are to be controlled. The software supports any type of instruction i.e, they can either be upper characters or Lower character or numbers or symbols. Once, if an instruction is given in the application, FPGA receives the instruction via serial port and then it checks whether the given instruction has valid address or not. If the instruction is valid then the corresponding appliance works and if it is not valid, the system will repeat the process until a valid instruction is given. For the system we have designed the external hardware for home automation using sensors. Circuit includes the following sensors are LDR sensor, motion sensor (PIR sensor), temperature sensor(LM35). These sensors are connected to appliances through relays. Relays are connected to the Pmod pins of FPGA Board

A) Hardware Implementation



Pmod Pinout	HDMI Type D Pinout	
JA1: T3	D0+: R3	SCL: C13
JA2: R3	D0-: T3	SDA: A13
JA3: P6	D1+: T4	CEC: Vcc
JA4: N5	D1-: V4	RES: Vcc
JA7: V9	D2+: N5	HPD: 5V
JA8: T9	D2-: P6	DDC: GND
JA9: V4	CLK+: T9	
JA10: T4	CLK-: V9	

Figure.2 Pairing Bluetooth with FPGA Board

The Pmod port is a 2x6 right-angle, 100-mil female connector that mates with standard 2x6 pin headers available from a variety of catalog distributors. The 12-pin Pmod port provides two VCC signals (pins 6 and 12), two Ground signals (pins 5 and 11), and eight logic signals. VCC and Ground pins can deliver up to 1A of current. Jumper JP12 selects the Pmod Vcc voltage (3.3V or 2.5V) in addition to selecting the VHDC voltage. Pmod data signals are not matched pairs, and they are routed using best-available tracks without impedance control or delay matching.

On the Atlys board, the eight Pmod signals are shared with eight data signals routed to an HDMI type D connector. The HDMI connector, located immediately beneath the Pmod port on the reverse side of the board, includes an I2C bus and conforms to the HDMI type D pinout specification, so it can be used as a secondary HDMI output port. A type D to type A HDMI cable may be required, and is available from Digilent and a variety of suppliers.

IV. Flow Chart of System Design

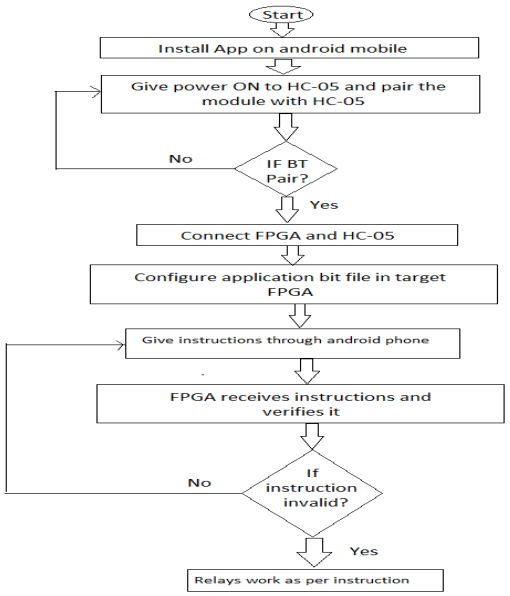


Figure.3 Flowchart of System Design

v. Results

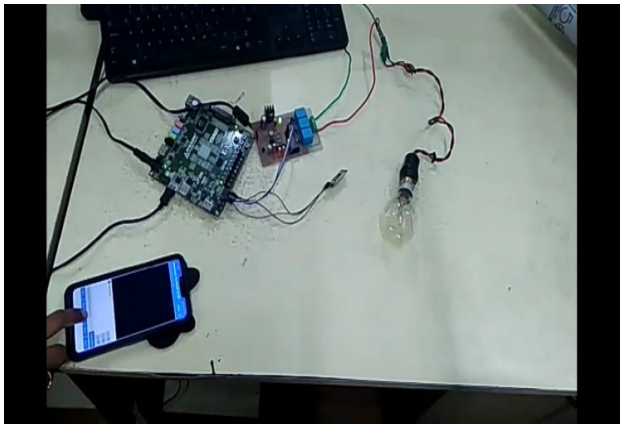


Figure.4 Hardware Implementation of System

Fig.4 shows hardware implementation of system. The Android mobile with the use of "Bluetooth Terminal "APP get connected with the HC-05 Bluetooth module. This module is connected with Spartan -6 FPGA Board through Pmod pin of the board. Through expansion connectors the bulb is connected via relay. The result indicates the on and off of bulb through mobile app.

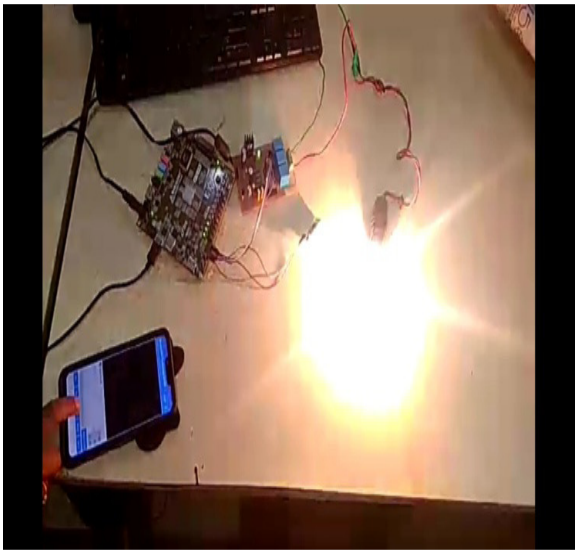


Figure 8. Controlling the bulb through mobile

V. Conclusion

The remote control function by smart phones provides help and assistance especially to disabled and elderly. In order to provide safety protection to the user, a low voltage activating switches is replaced current electrical switches. Bluetooth based home automation is flexible and low cost. Implementation of wireless Bluetooth connection in control board allows the system install in more simple way. The control board is directly installed beside the switches whereby the switching connection is controlled by relay.

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