ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 7, July 2013

ADVANCE HOME AUTOMATION USING FPGA CONTROLLER

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Abstract-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. 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.

Keywords-Home automation, Speech recognition, Bluetooth, pic microcontroller, FPGA

1. INTRODUCTION

The home automation improves the lifestyle of the control of the home devices. As the devices are filling the home, the home appliances are filling the homes to improve the comfort to the user. Here we are using FPGA as controller to control the devices connected to it. We monitor the devices wirelessly by using the Bluetooth. We are using the android mobile for speech recognition. We are using the FPGA other than the micro controller because we can connect many devices which can be monitored and the FPGA can be used as a controller or a processor. The devices connected to the FPGA are the dc motor, stepper motor and a led .With the help of dc motor we are constructing a robot and controlling the navigation of robot with the help of the android mobile.

2. BACKGROUND WORK

The advancement of technology has increased the usage of the electronic devices in homes. The wireless technology is most popular technology to control the devices from distances.

In [2] the authors introduce the idea of using Bluetooth as a cable replacement for home automation. However, no implementation details are given. An automation system based on Bluetooth was developed in [3]. It consists of a remote and a mobile host controller that communicates with several devices representing the home appliances. A similar solution was presented in [4], where a Bluetooth multihop mesh topology was used to relay sensor node information to a mobile phone or a personal computer [4].

The author in [5] uses the pic microcontroller to control the sensors through the SMS having password. The GSM module system uses mobile network and is battery powered which makes home automation system safer from internet hacks.

In their work in [6] the authors have used the Zigbee technology and the routing algorithm. The routing algorithm is used to deduce the optimal path. Monitoring system is built using GPRS network.

In their wok in [7] the authors have used the GSM Network, Internet and speech recognition. The GSM and internet are used for remote monitoring and speech recognition is used within the house. The advantage of GSM is that the communication between the home and the user is its wide range which makes the whole system online and it is high secured so that information cannot be monitored by an eavesdropper. The communication between the home appliances is carried out by RF communication protocol which has an advantage of installation and maintenance. In their work in [8] the authors have used the cloud computing technique so that the user can control and monitor the device real time from anywhere through the internet. It reduces the setup and maintenance cost by eliminating the need for specialized gateway and web server. In their work in [9] the authors have used the Zigbee technology and web service to remotely control the devices. It is a specification suite of networking, security and application software layers using small, low power, low data rate communication technology for personal area network.

3. IMPLEMENTATION OF HOME AUTOMATION SYSTEM

A block diagram of the implemented system is shown in Figure 1. It consists of an android mobile phone having a Bluetooth interface, a Bluetooth module, a pic microcontroller, a central FPGA controller, that communicates via the RS-232 protocol to the Bluetooth interface, and a number of devices which are connected to the central controller. The implemented system connects the robot, bulb and a motor device to the

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controller. These devices can be controlled using the Bluetooth and mobile devices through speech recognition application.

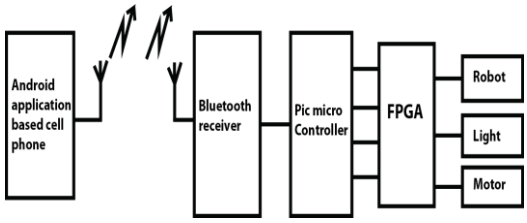


Figure 1.Block Diagram of proposed system

4. BLOCK DIAGRAM DESCRIPTION

The following discussions are based on the individual blocks of the proposed block diagram.

4.1Bluetooth Interface

The central FPGA controller communicates with the Bluetooth module through a serial interface. This requires a Universal Asynchronous Receiver /Transmitter (UART) which is employed on FPGA. This technology was selected over other solutions because it is available in most mobile phones, it can be implemented with low cost, it consumes low power, and provides a level of security through its use in short distances and through its pairing function. The mobile device communicates to its inbuilt Bluetooth module. On the other hand, a Bluetooth module must be interfaced with the PIC microcontroller, where accurate clocking must be generated for the UART to correctly interpret the received data.

4.2 Mobile Device

The system requires an android mobile device having a Bluetooth module. The mobile is used for speech recognition. This application is developed using the java software. It is used for the controlling of the devices which are connected to the controller using Bluetooth technology.

4.3 PIC Microcontroller

The PIC Microcontroller is used to receive the data from the Bluetooth receiver serially. The data received is converted to digital form using the PIC Microcontroller and the data is transmitted parallely to the FPGA controller.

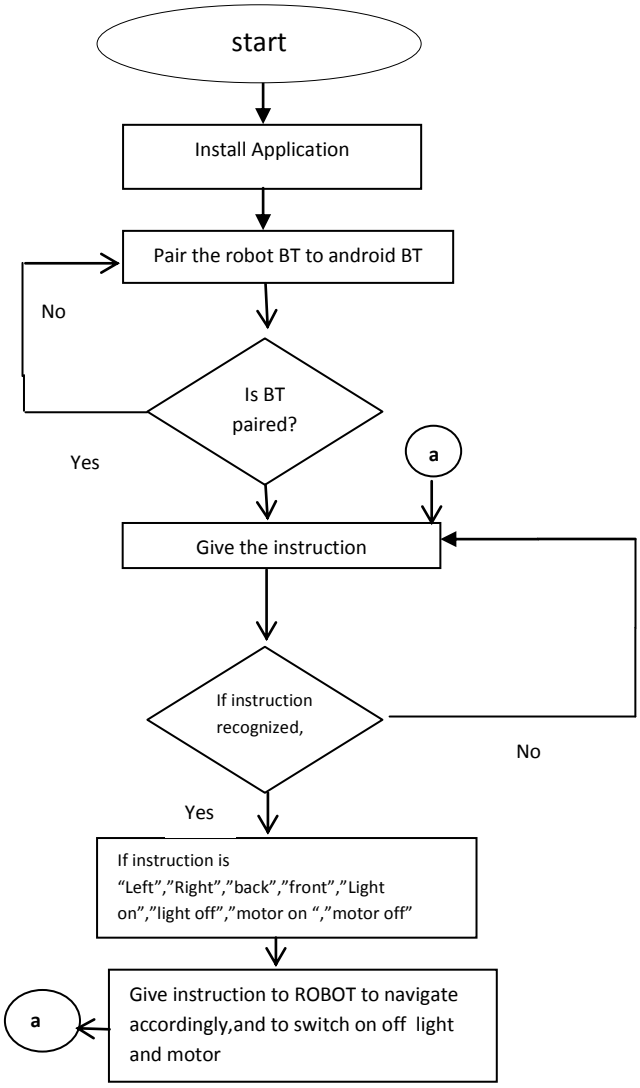
4.4 Control and Monitoring Devices

The number of control and monitoring devices attached to the FPGA depend on the number of free input/output ports available on the FPGA. The implemented system uses the parallel communication so that the speed is increased. The devices are directly connected to the FPGA Controller and are controlled using the speech recognition technique.

5. WORKING OF THE SYSTEM

The FPGA controller is implemented on a Basys2 development board which uses a Xilinx Spartan-3E using the Very High Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL). The devices which need to be controlled are directly connected to the FPGA controller; here we are connecting the dc motor, stepper motor, and LED. By using the dc motor we are controlling the robot navigation. The android mobile is used for speech recognition, speech is converted to the text and transmitted to the Bluetooth module using the Bluetooth technology, the Bluetooth module receives the signal and transmits it to the pic microcontroller using the UART using the transmit and the receive unit. The software developed for the navigation application on the mobile device was coded in Java. The Java Bluetooth API was employed in phone to communicate with the Bluetooth hardware. On the initialization of the application a search procedure is initialized where nearby Bluetooth devices are discovered and services are noted and then we can pair with the device which we want to connect this allow some level of security.

FLOW CHART



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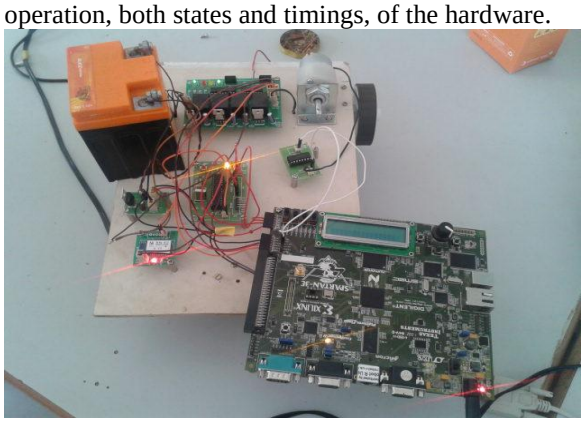
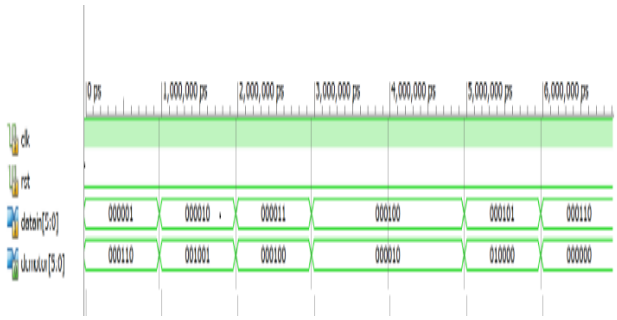
The flowchart of the implemented project is shown in the figure, first the Bluetooth is paired with the mobile Bluetooth with the security code if the pairing is completed than the instruction are given than the instruction is checked with the code if it is recognized than the operation is performed

6. RESULTS

VHDL test benches were designed to test all the developed VHDL code both at block level and at top level before downloading the synthesized code on the FPGA. The waveforms were checked to verify correct operation, both states and timings, of the hardware.





7. CONCLUSION

The implementation of home automation using FPGA is achieved. Furthermore, the system is expanded by cascading FPGAs or by multiplexing data coming from different devices. This makes the system scalable. The devices connected to the FPGA can use either a wired connection or a wireless one, such as Zigbee or Infra-red. In this implemented module wired solutions can be used, however, the interface can be easily replaced by a wireless solution. The implemented modules can interface the robot, bulb and the motor and can control the modules by switch on and off and control the direction of movement of the robot. The dc motor can be used in the devices like mixer, vacuum cleaner, refrigerator and stepper motor can be used in the devices like toaster, magnetic door lock.

We can mount the camera on the robot and it can be used to capture the image and this can be sent to the remote area.

REFERENCE

[1] Bluetooth SIG, Inc. (2010). The official Bluetooth® technology info site.[Online]. Available: http://www.bluetooth.com

[2] R. Shepherd, "Bluetooth wireless technology in the home," Journal of Electronics and Communication Engineering, vol. 13, no. 5, pp. 195-203, Oct. 2001.

[3] N. Sriskanthan, F. Tan, and A. Karande, "Bluetooth based home automation system." Microprocessors and Microsystems, no. 26, pp.
281 - 289, 2002.

[4] G. Song, Z. Wei, W. Zhang and A. Song, "Design of a networked monitoring system for home automation," IEEE Trans. on Consumer Electronics, vol. 53, no. 3, pp. 933 - 937, Aug. 2007.

[5] Sheikh Izzal Azid, Sushil Kumar,"Analysis and performance of a low cost sms based home security system",july.2011

[6] Ming Xu, Longhua Ma,Feng Xia,Tengkai Yuan,Jixin Qian,Meng Shao,"Design and implementation of a wireless sensor network for smart homes"

[7] Baris Yuksekkaya, A.Alper Kayalar, M.Bilegehan Tosun, Kaan Ozcan, and Ali Ziya Alkar,"A GSM, internet and speech controlled wireless interactive home automation system",july.2006

[8] Anindya Maiti,"Home automation as a service",june.2012

[9] Soyoung Hwang and Donghui Yu,"Remote monitoring and controlling system based on Zigbee networks",july,2012