

# Home Automation Using FPGA Controller

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**Abstract:** This paper presents the design and implementation of a wireless monitoring system used for home automation. The proposed system consist of devices controlled by the user using mobile phones. This is done by using FPGA kit as a controller to which devices are directly interfaced. Bluetooth module is used to communicate with the FPGA kit and android application is created to control the devices.

**Keywords**—Wireless networking , home automation, Bluetooth, android application.

## 1. Introduction

Home automation provides comfort to the user. It is used to control home appliances, sensors. We monitor the devices via mobile application. We are using FPGA controller other than microcontroller because we can control more number of devices. By sending signal via Bluetooth module we are going to control devices mounted on FPGA board. FPGA is more superior for Automation as compared to other controllers as it has logic gates inbuilt in it and all provide parallel working of appliance with less number of IC's.

## 2. Background of Work

The wireless home automation has become the most popular technique to control the devices. In [2]the author introduces idea of Bluetooth as a replacement of wired technology for home automation. Bluetooth automated system was developed in[3],it consisted of a remote and a mobile host controller that communicates with the home appliances. In[4] Bluetooth multi-hop mesh topology was used to relay sensor node information to a mobile phone or personal computer. In[5] author uses pic microcontroller to control the sensors through SMS. The authors in [6] have used zig-bee technology and routing protocol.

In their work in [7] have used GSM module, Internet and speech recognition. It was an easy technique to control the home appliances. In [9] authors have used

the Zig-bee technology and web service to control the devices. It used low power and had low data rate.

## 3. Implement Of Home Automation

### 3.1 BLOCK DIAGRAM

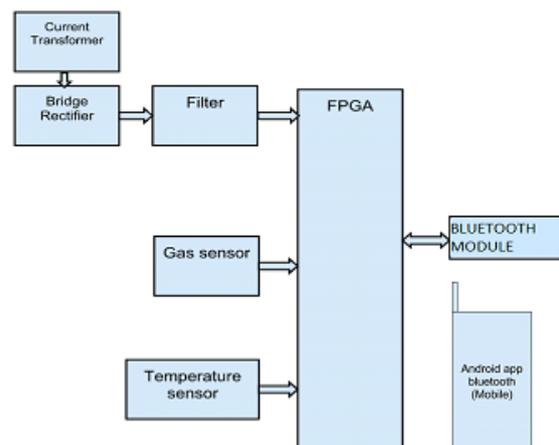


Fig 1.1

The above Fig. 1.1 represents the block diagram of Home Automation and also provide the basic interfaced used in our project .In place of filter we are using basic capacitor for filtering of glitches on the Dc signal and Rectifier is used to convert Ac power to Dc.

### 3.2 BLUETOOTH INTERFACE

The Bluetooth module communicates to FPGA controller through a serial interface. It requires Universal Asynchronous Transmitter and Receiver which is employed on the FPGA. Bluetooth technique is used because it is implemented with low cost, low power consumption and a level of security is required because of authentication and authorization. It is used for short distances. It is used to control devices and generates alarms for sensors.

### 3.3 MOBILE DEVICE

The system requires an android system having a Bluetooth module in it. The android application is developed using java language and basic for you software. It is used for controlling of the devices which are connected to the controller using Bluetooth module.

### 3.4 CONTROL AND MONITORING DEVICES

Here the controller used to monitor and control the devices is the FPGA controller. The number of devices are controlled. There are various ports available for input and output of devices. Bluetooth communicates with the FPGA controller to control and monitor the devices.

## 4. Working Of The System

In our project we are using VHDL (Very High Speed Integrated Circuit Hardware Description Language). The devices are controlled by the FPGA kit that receives commands from the Bluetooth module. Here we can connect two ac devices, dc motor and temperature, gas sensors. The android application is created to control off and on the devices, to get updates of the sensors used. The Bluetooth module receives and transmits signals to the FPGA kit.

## 5. Algorithm

1. START the Android app in the mobile.
2. GIVE power to FPGA kit.
3. PAIR mobile with FPGA kit with Bluetooth.
4. SEND instruction from Mobile app to FPGA.
5. FPGA should work and monitor appliances according to the given instructions.
6. SEND another instruction if earlier process is done or RESEND same instruction again.
7. ALL the appliances should work according to mobile app.

## 6. Steps Of Implementation

1. First decide the port of FPGA kit to be used to interface for hardware appliances.
2. Design the hardware kit according to user appliances for ex. We have used Led , DC-fan ,Buzzer, Sensors and 2 sockets(240V).

3. Implement language for your FPGA kit on Xilinx software.



Fig. 2.1

Integrated Synthesis Environment is a software tool produced by Xilinx for analysis of HDL designs, enabling the developer to make their designs, performs timing analysis, check RTL diagrams, simulate a design reaction to different stimulation, and configure the target device with the programmer. Xilinx ISE is a design for FPGA products from Xilinx software. The Xilinx ISE is used for circuit synthesis and design, while ISIM or the Model Sim logic simulator is used for system-level testing.

4. The above Fig. 2.1 shows the simulation of Analog to Digital converter we have used for our Sensors in the project.

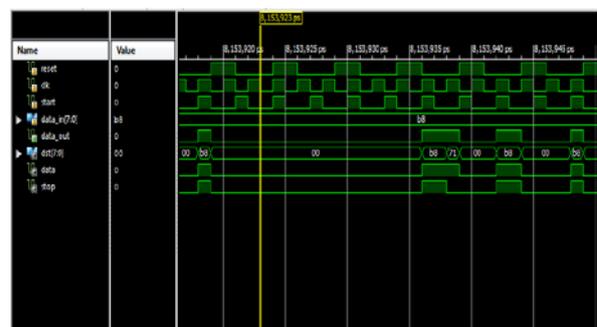


Fig. 2.2

5. The above Fig. 2.2 shows the simulation of Transmission of signal from FPGA to appliances with respect to the clock. The Fig. 2.2 is the Real-Time image of the simulation from Xilinx ISE.

6. After simulation make an Android app for Mobile to connect through Bluetooth to FPGA. We have used B4A (Basics for Android) for making android application.

7. B4A is a visual designer that simplifies the process of making user interfaces that target phones and tablets with different screen sizes. After Compile programs in AVD Manager or on real Android devices using Android Debug

Bridge ie.B4A Bridge. The language is similar to Visual Basic and Visual Basic .Net though it is adapted to the native Android environment. B4A is an object-based and event-driven language.

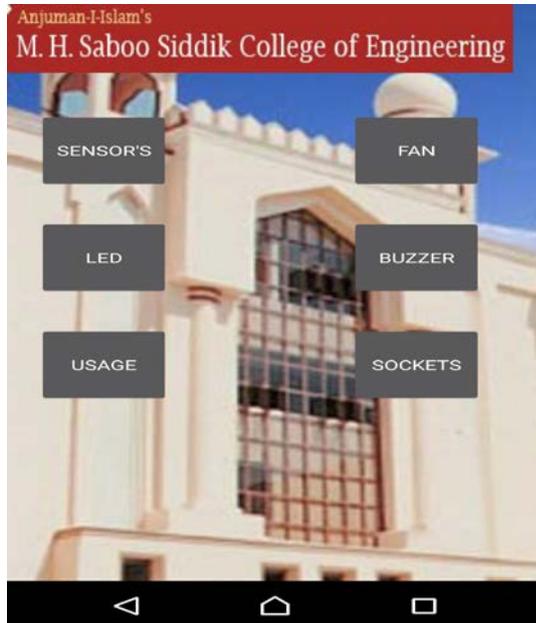


Fig. 3.1

8. The above Fig. 3.1 shows the image of Android app we created on B4A application. This is basic homepage of Automation in which it is clearly displayed the Types of appliances used.



Fig. 3.2

9. The above Fig. 3.2 is the complete hardware view of appliance, current transformer and other circuitry. The relays are used for switching purpose of appliances and there is a Bluetooth module HC-05 at top right corner of image, where as other appliances present image is buzzer, fan and led.

## 7. Result

VHDL coding is used to control the devices by the FPGA. The waveforms were checked to verify

correct operation, both states and timings, of the hardware.the android application was checked on phone for proper working of the commands given to the devices.

## 8. Conclusion

The implementation of home automation by FPGA controller via Bluetooth is achieved. The devices connected to FPGA can be wired or wireless connection. In our project wired connected devices were used. Further expansion can be done to comfort the users .Future applications can be hospital automation, garden automation etc.

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