IOT BASED HOME AUTOMATION USING FPGA

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Abstract: Internet of Things (IOT) had many applications in several domains; it also strides into smart homes. Controlling appliances with IOT can be easily done using Smart phone through Android apps. Home automation is one of the profound in day to day applications. Due to hasty progress in technology, Wireless Fidelity (Wi-Fi) has brought revolutionary change than compared to Wired LAN communication. Existing wireless communication devices such as Bluetooth, Zig Bee and NRF24L 01 etc. are limited to short range. IOT uses Wi-Fi to exchange data wirelessly for large distances using Internet. IOT module (ESP8266) is used to control the home industrial appliances in remote areas anywhere in the world. Serial Communication exchanges the data between FPGA and IOT module. Home appliances are controlled using FPGA which receives commands in serial communication from IOT Module through smart phone app. Compare to existing home automation; IOT based home automation can update device status with E-Mail alerts and also in web with IP address which can be password protected. Due to its high precision and smart phone technology helps for physically challenged and senior citizens.

Index Terms – **Internet of Things, Wi-fi, ESP8266,**

I. INTRODUCTION

The enormous developments in present day developing innovation, people are adjusted to these innovations from multiple points of view. Communication means sharing information from one point to another point. It can be done in mainly two ways, wired communication and wireless communication. Wireless communication plays a dominant role in present scenario because of its high security and easy accessibility. IOT, technology dominates Bluetooth technology because it is limited to certain area. But IOT can be accessed by IP protocols and be connected through web and can be accessed throughout the world. Now present Bluetooth technology can be accessed only in terms of meters but IOT technology can be accessed throughout the world by means of IOT modules which are very cheap in the market.

IOT is the upcoming trend and future will depend on this. There are number of Bluetooth Modules available in the market but compared to them IOT modules are more reliable and cheaper and also had many applications such as home automation, intelligent shopping system, etc. Home automation can be done easily with the help of IOT technology. Monitoring and controlling home appliances can be done using IOT modules. The IOT module used here is ESP8266 (Node MCU).

The internet of things is the system of physical items or things installed with hardware, programming, sensors and system network which empowers these objects to gather and trade information. Home automation is likewise a noteworthy stride forward with regards to applying IOT. Every one of these advances add to the various rundown of IOT applications. Presently with IOT, we can control the electrical gadgets introduced in our home while we are sorting out our records in office. Our water will be warm when we get up in the morning for the shower. All credit goes to brilliant gadgets which make up the savvy home. Above all else when planning a home automation framework, we need to think about as some issues such as the client ought to have the capacity to associate with that IOT module from any gadget (Android mobile) he would wish to. He ought to have the capacity to change the host from one gadget to other gadget and that module ought to work in like manner. On the off chance that any shortcoming happens it ought to have the capacity to analyze it and the framework to work promptly when a direction is given to enhance the way of remote innovation.

1.1 Objective

The prime objective of the project is designing a home automation system using IOT that is capable of providing home automation based services using controlling devices according to the requirement of the user. The academic goal of this project is to develop specific skills in designing, programming, testing and debugging.

1.2 Literature Survey

Many papers we have referred for this project. Paper title "Home Automation through FPGA controller "[1]. In this paper Design and Implementation of home automation system. The design has been described using Verilog and implemented in hardware using FPGA. Another paper title "Implementation of smart home automation system on FPGA board using IOT" [2]. Intelligence based on microprocessor is used by home automation to incorporate electronic structure 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. The paper title "Implementation of low cost IOT based Home automation system on Spartan FPGA" [3]. In this works design and implementation of home automation system and design has been described using VHDL and implementation in hardware using FPGA where sensor are interfaced to it. This system uses IOT to establish the communication between network and controller. The paper Title "FPGA based embedded architecture for IOT home automation application" [4]. In this an IOT FPGA based home hub to automate control operation in home environment was design and built. The proposed system uses an FPGA home hub as its local analysis engine with IOT platform to store the sensory data. This shows promising application of FPGA in supporting sealable IOT home Automation system.

1.3 RESEARCH METHODOLOGY

Our project is to design a FPGA base home monitoring system. We are using the FPGA other than the microcontroller because we can connect many device which can be monitored and the FPGA can be used as a controller a processor. The device connected to FPGA are the DC motor, stepper motor and LED. The design has been describe using Verilog and implemented in hardware using FPGA (Field Programmable Gate array). This system uses sensor for controlling home appliances. This system uses wireless technology to improve the standard of living.
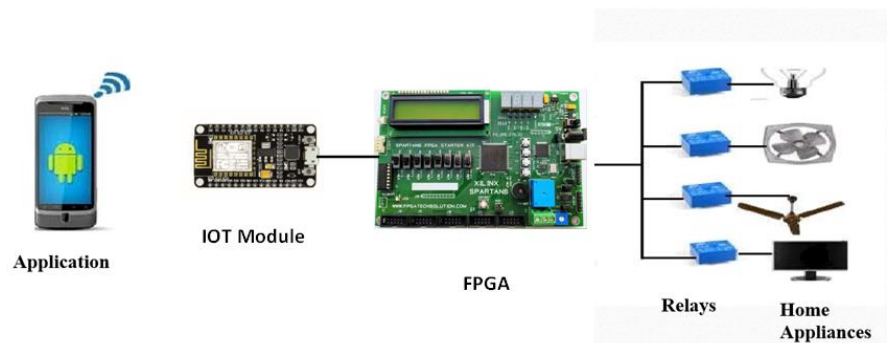
3.1 Block Diagram

Figure 1

The basic flow of the circuit connection goes as per the block diagram. At first is the Mobile phone where basically we develop an Android Application through which we can control the end devices. The Application is developed using MIT App invertor which is an online open-source platform. The next is the IOT Module that is ESP 8266 (Node MCU) it is a Universal Asynchronous Receiver/ Transmitter to Wi-Fi module. This module is easy to use and can be easily connected to any FPGA wirelessly to the internet. By simply connecting FPGA to the IOT Module serial communication can be done using the Internet. The next connected is the FPGA Board where we design hardware by coding for this project, we have used Verilog language which is a hardware descriptive language. FPGA board controls the home appliances through relays. FPGA provides flexibility and security. It basically comprises of all the instructions that are utilized to control the home appliances. At the end are the Home appliances where we are using a Bulb and Fan. Fan (1000 RPM Motor) is connected to the DC motor driver and the Bulb is connected to the 5v Relay present on the FPGA Board.

3.2 Components Description

Android Phone: To develop a conventional App using MIT app inventor for controlling and monitoring end devices.
IOT Module: ESP8266 (Node MCU) a UART module which is perfect for this project considering the use of FPGA.
FPGA Board: Cyclone II EP2C5T144 Home appliances EP are controlled using FPGA which receive commands in serial communication from IOT Module through smart phone.
5V Relay: It is used to connect the end appliances with the FPGA board.
End Devices: Here we're using Fan and LED Bulb as the end devices.
MIT App Inventor: MIT App Inventor is a web application integrated development environment. It uses a graphical user interface, which allows users to drag and drop visual objects to create an application that can run on android devices.
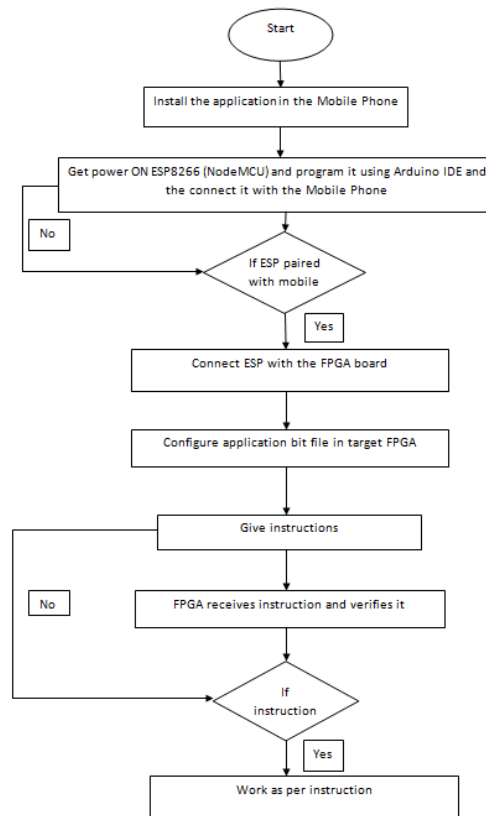
3.3 Flow Chart

Figure 2

IV. RESULTS AND DISCUSSION

4.1 Results

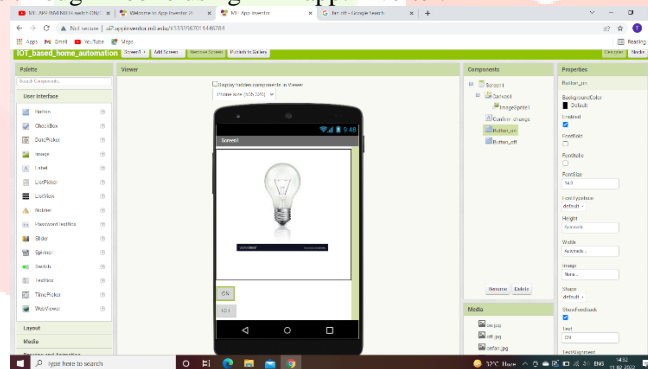App is designed to control devices through mobile using MIT app. Inverter.

Figure 3

Expected to Turn on/off devices as per selection.

4.2 Conclusion

This project IOT Based Home Automation using FPGA Board helps us control all the home appliances by just the use of our phone through the android application. Everything right at the tip of our fingers. This can be really beneficial for senior citizens, rather than getting up to switch on/off the lights or fans everything could be managed by their own by just using the application developed without anyone's help. This can also be used in hospitals where an injured person can operate the appliances right from his bed. Also considering pandemic issues this can also maintain distances and also avoid physically touching the switch. Where the individual will use their own phone application. Home automation is the future which is handy and very easy to use. In our project FPGA Board provides high output stability where later many numbers of application can be added. FPGA also provides high security where errors are reduced.

4.3 FUTURE SCOPE

This system is designed control the home automatized equipment's like fan, bulb etc. The future scope of this project will be to add more number of applications in the project, as FPGA has a high output stability which can control many end devices as applications. Also if possible, it can be used on a large scale and almost every equipment in our house right from unlocking the door to controlling the fan, television, lights etc. can be controlled wirelessly just through an application or web. Also controlling the light intensity and speed of fan will be another future scope for this project. This project is being implemented to control only these devices but can be expanded later on to control more devices or processes and also can be web enabled.

4.4 APPLICATION

This idea can be implemented on large scale to provide applications like:

- Heating, ventilation, and air conditioning
- Lawn/Gardening management
- Smart Home Appliances
- Improved Home safety and security
- Home air quality and water quality monitoring
- Natural Language-based voice assistants
- AI-driven digital experiences
- Smart Switches
- Smart Locks
- Smart Energy Meters

II. References

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