A Novel Implementation of Electrical Appliances Controller Using FPGA

Dr. M. Kamaraju, V. Swathi
1Dept. of ECE, Gudlavalleru Engineering College

Abstract
Now a days, the usage of electronic appliances is increasing. In the offices, employees left their rooms without switching off the electrical appliances. So the power wastage increases. This power wastage can be reduced by making an intelligent system, which can control the electrical appliances automatically based on the requirement. The whole system is implemented and tested on FPGA.

Keywords
Power, FPGA

I. Introduction
There are various monitoring and control systems like Home security monitoring and control system [1], Street light monitoring and control system [2-3], Railway monitoring system, Temperature monitoring system, Patient monitoring system etc., for different purposes.

The existing system monitors and controls the electrical appliances based on the microcontroller. The existing system uses Zigbee modem for communication and Remote control unit to control the appliances. Basically Zigbee is used for long distance communication in wireless communication. Bluetooth and Infrared can’t be used for long distance communication [4]. Zigbee builds upon physical layer and medium access control layer defined in IEEE 802.15.4 for low-rate WPANs [5-6]. The existing system uses more hardware and we can’t add new features to the system.

The proposed system which is implemented on FPGA acheives reconfigurability.

In this system Zigbee modem has to be implemented on FPGA. So study of different modems implemented on FPGA is necessary [7-11].

II. Proposed System

Fig. 1 shows the block diagram of Electrical appliances controller. In Fig. 1 the PC(personal computer) transmits the necessary information through modem. Personal computer controls the electrical appliances with the help of modems and remote control unit. In fig. 1 “loads” indicate the electrical appliances. The system uses four modems. One modem is placed at the transmitter and remaining 3 modems are placed at receivers in 3 floors. Zigbee modems are used to provide communication for long distance. Zigbee modem uses Offset-Qpsk modulation and Offset-Qpsk demodulation techniques [12] for transmission and reception. These techniques have some advantages when compared to remaining techniques. The purpose of modem is to transmit and receive the necessary information to control the electrical appliances automatically. The purpose of remote control unit is to control the electrical appliances.

The system is designed for 3 floors in the office. To control the electrical appliances automatically, the system has zigbee modems at both transmitter and receiver. The zigbee modem at personal computer will send the necessary information to each floor. One RCU(Remote Control Unit) is placed in each floor. Each RCU can control 16 electrical appliances and each RCU is given unique ID. Actually the information will be transmitted to the 3 floors. In the each floor, RCU checks input message whether the received command belongs to the corresponding floor or not. If ID matches with 1st floor, the appliances in the 1st floor can be controlled.

The electrical appliances may be of any kind like lights,fans,air conditions etc., This system is meant for industry applications i.e., mainly in the offices.

If employees do not switch off ACs, lot of power will be wasted because it consumes more power than any other electrical appliances. So this system saves lot of power by switching off the appliances automatically.

III. Implementation

Algorithm for top level module of Electrical appliances controller:
Step1:Start
Step2:Define inputs and outputs
Step3:Call the transmitter function to establish communication
Step4:Call the receiver1 function and check whether ID matches with first floor or not
Step5:Call the receiver2 function and check whether ID matches with second floor or not
Step6:Call the receiver3 function and check whether ID matches with third floor or not
Step7:Control the appliances in the particular floor
Step8:Stop

In the algorithm, after defining inputs and outputs transmitter function will be called to transmit the information. The necessary information will be transmitted from transmitter to all the receivers. Each receiver checks ID and the appliances in the corresponding floor can be controlled.
IV. Results
The code is written in Verilog HDL using Xilinx platform. The simulation results are obtained in case of 3 receivers in 3 floors. Schematics are obtained to observe the internal structure of the system.

Fig. 2: Floor Control Simulation Result

In fig. 2 the first 4 digits of hexadecimal number i.e., ‘1111’ represent first floor. So the appliances of first floor can be controlled.

Fig. 3: RTL Schematic of Transmitter Section

Fig. 3 & 4 shows the RTL schematics of transmitter and receiver. In these two diagrams, transmitters and receivers are shown in terms of digital components like logic gates, flip-flops etc.,

Fig. 4: RTL Schematic of Receiver Section

Fig. 5: Utilization of FPGA Resources
Fig. 5, illustrates the utilization of FPGA resources in terms of percentage. From this information we can understand how the system is occupying the resources of FPGA. Resources of FPGA include LUTs, FFs, IOBs, etc.

V. Conclusion

Power can be saved with the help of this system. Existing system uses lots of hardware and it has no reconfigurability. In this system, all components of existing system are implemented on single FPGA chip. So with the help of single FPGA chip, the electrical appliances can be controlled effectively and efficiently.

References


He did his B.E & M.Eng from Andhra University. Ph.D from Jawaharlal Nehru Technological University Hyderabad(JNTUH). He has Experience of 19 years in the field of teaching and research experience of 5 years in the field of VLSI design. Published 25 research papers at various international journals, international conferences and national conferences. He is working as Editorial board member of International journal of VLSI Design and Communication Systems (IJVLSICS) and Designated reviewer for various IEEE international conferences organized outside of INDIA. Presently he is working as Professor & Head in the department of Electronics and Communication Engineering, Gudlavalleru Engineering College, Gudlavalleru.

She did B.Tech from Malineni Lakshmaiah Engineering College. She did M.Tech from Gudlavalleru Engineering college. She has Experience of 1 year in teaching field. She published a paper at National Conference.