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Design of Intelligent Home Appliance Control System using ARM, ZIGBEE and GPRS

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Abstract

Intelligent home appliance control system makes use of modern computer and cellular technologies to control home appliances in a faster, cheaper and in an energy efficient way. This work presents a home appliance control system which is developed through ARM microprocessor, Zigbee wireless communication technology and GPRS cellular technology. In this system, user can control appliances through a hand held mobile terminal. The system operates in two modes – zigbee mode/ indoor mode and GPRS mode/ outdoor mode. User can control appliances through zigbee when at home or through GPRS when away from home. User will send commands to the receiver from hand held terminal. In Zigbee mode commands will be generated through a hand held control device and in GPRS mode commands will be generated through buttons on cell phone. The aim of this appliance control system is to control the devices remotely as well as in close proximity. The communication between the devices is wireless.

***Keywords*: ARM, Zigbee, GPRS, Wireless controlling, Remote controlling.**

1. Introduction

Home automation is a modern technology that modifies our home to perform different sets of task automatically. Home automation is gaining more recognition among the people not just for home modification but in industrial and business sectors too. It is constantly improving its flexibility by incorporating modernized features to satisfy the increasing demand of the people. With the help of intelligent home technologies, there is increased comfort, greater security in life and safety. Technological advancements, such as the development and widespread use of wireless technology such as Bluetooth, zigbee etc. combined with readily inexpensive internet access, has spurred many ideas and innovations to apply those technology in the home. Wireless technologies are becoming more popular around the world and the consumers appreciate this wireless lifestyle which gives them relieve of the well known wiring. Now with the wireless technology digital devices form a network in which the appliances and devices can communicate with each other.

2. Methodology

The proposed design is an intelligent home appliance control system which controls the home appliances like Bulb, Fan, TV, fridge, microwave, etc. This system has evolved as a result of thorough study of the different systems.

This proposed intelligent home appliance control system is developed through ARM microprocessor, embedded C, Zigbee wireless communication technology, and GPRS for worldwide controlling. In the proposed system user can control appliances through hand held mobile terminal when at home via Zigbee or from anywhere in the world through cellphone via GPRS. i.e. this system can be operated in two modes:

a. Indoor mode through Zigbee
b. Outdoor mode through GPRS

The overall structure of the system can be divided into Hand held terminal and Receiver section. The hand-held terminal will be a control device when the system is operated in indoor mode and it will be cellphone when the system is operated in outdoor mode. The receiver section

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is common in both the modes. The system can be explained as follows

2.1 Block Diagram of Transmitter

For Zigbee mode, in transmitter PIC controller is used which is interfaced with Graphical LCD, touch screen and Zigbee. On graphical LCD the symbols of different appliances will be present that will be pressed. The commands will be transmitted through zigbee. For GPRS mode, Mobile handset is used. From mobile phone commands will be sent and the respective action will be performed. The following figures show the transmitter sections for indoor and outdoor mode.

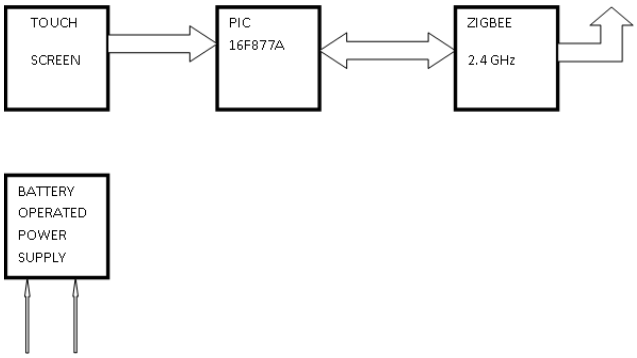

Fig 1. Block diagram of transmitter(indoor mode)

Fig 2. Block diagram of transmitter(outdoor mode)

2.1.1 Transmission through Zigbee:

Figure 1 shows the transmitter section when the system is operating in the indoor mode. In this it consists of PIC 16F877A which is a 40pin IC and is an excellent choice for systems whose control code fits within a small footprint. It has zigbee series2 operating at 2.4 GHz [6]. It consists of Graphical LCD and a touch screen which displays the icons of different appliances. The user can select a particular appliance through the touch screen and control it. The instruction will be sent to the PIC microcontroller which will be sent to the Zigbee and transmitted to the receiver section.

2.1.2 Transmission through GPRS link from Mobile phone:

Figure 2 shows the transmitter section when the system is operated in the outdoor mode. In this case mobile handset with internet is used. The transmitter is a mobile that will be programmed with the J2ME programming and the appliances can be controlled from anywhere in the world by pressing the buttons on the mobile phone.

2.2 Block Diagram of Receiver

In transmitter ARM processor is used which is interfaced with LCD, GPRS MODEM and relay driver. The commands are received through Zigbee and GPRS and the respective relays will control the appliances accordingly.

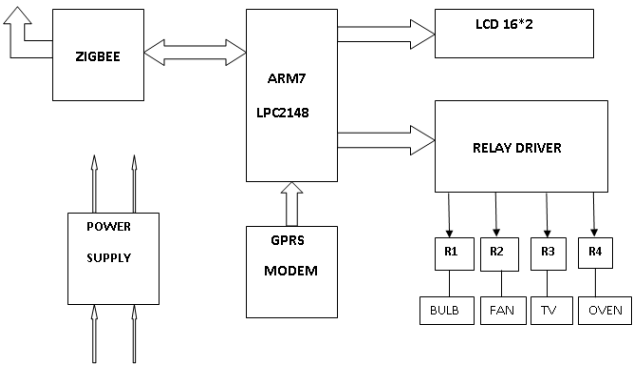

Fig 3. Block Diagram of Receiver

Figure 3 shows the receiver section which consists of ARM7 LPC2148 as the core processor, Zigbee series2 operating at 2.4 GHz. Relay driver is connected to the ARM and four relays are connected to the relay driver. Four different appliances are connected to the relays. ARM processor receives signals from the transmitter through the Zigbee. It further processes the signal and control actions are done through the relay driver. It also has a LCD 16*2 display. It has a GPRS modem that is used to receive signals from the mobile when the user is outside the house.

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A toggle switch is connected to the ARM Processor that can be used to select between the indoor and outdoor mode.

The modes in which the system operates are as follows:-

Zigbee mode/ Indoor mode: - Consider the case in which we need to switch ON/OFF the TV. We can select the TV by touching the TV icon on the touch screen and switch the TV ON/OFF. The instruction will be sent to the PIC microcontroller and it will be sent to the Zigbee. The zigbee will send a signal to the receiver zigbee. At the receiver the signal will be sent to the ARM processor. The processor will accordingly control the TV through the relay driver.

GPRS mode/ Outdoor mode: - Consider the case in which we are outside the house and have left the fan ON. In that case we can control the fan through our mobile phone via GPRS. A GPRS modem is used at the receiver section that will receive the signal and the desired action will be done accordingly through ARM microprocessor.

3. Conclusions

In this work a low cost, secure, remotely as well as closely controlled solution for automation of homes has been designed. This design is novel and has achieved the target of controlling home appliances through Zigbee wireless communication technology and GPRS cellular technology. The system operates in two modes for indoor as well as outdoor controlling of devices. The symbols of appliances in transmitter section are pressed and then the signal is received by the ARM processor at the receiver section through Zigbee (indoor mode) or GPRS (outdoor mode). The processor processes the information and accordingly switches ON/OFF the devices connected to relay.
This system provides home safety and convenience and is cost effective as compared to the previously existing systems. The design is suitable for most of the appliances. This system is convenient to use and more levels can be further developed.

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