



Energy Efficient Home Automation System using ZIGBEE and GPRS

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Abstract: This system makes use of modern computer and cellular technologies to control home appliances in a faster, cheaper and an energy efficient way. This paper presents a home appliance control system which is developed through ARM processor, ZigBee wireless communication technology and GPRS technology. In this system, user can control appliances through a handset mobile terminal or from a PC (connected to internet). This system has two sections. One section receives the commands from the PC or mobile terminal connected to the internet through GPRS. From this section, the commands go to other section which controls the appliances status. The transfer of commands from one section to other section is done through ZigBee module. Thus this paper deals about the controlling of devices by the user from a remote place.

Keywords: ARM-LPC2148, ZigBee, GPRS.

I. INTRODUCTION

An embedded system is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few predefined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale. Home automation is a modern technology that modifies our home to perform different sets of task automatically or manually. 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.

II. METHODOLOGY

Energy efficient home automation system consists of two sections. Section1 receives the commands from the PC or mobile terminal connected through internet through GPRS. Section2 is connected to the devices which are to be controlled. The connection between the two sections is established by ZigBee module i.e. the transfer of data between the two sections is established by wireless technology. The working of this project starts from the user

who controls his/her respective house from a remote area. The user is allowed to enter the URL address to open the web page. From that page the devices in the home are controlled. The commands sent from the web page are transferred to the home. There are two sections in the home. One section receives the command from the web page via GPRS. These commands are transferred to another section by ZigBee module. So at here the status of the devices can be controlled.

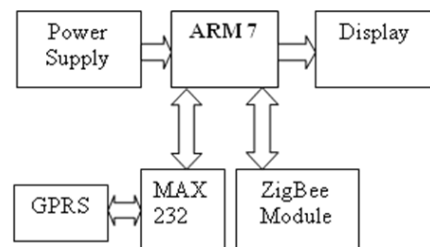


Figure1. Section1.

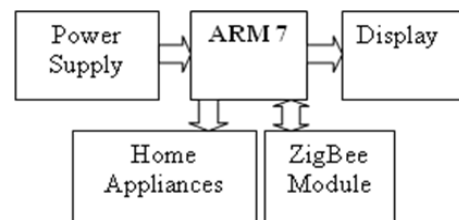


Figure2. Section2.

Here section1 consists of a power supply to supply power to the ARM7 and also to other modules. GPRS module is connected to microprocessor through MAX 232 IC. This IC

converts analog values to the digital. GPRS module is used to receive the instructions given by the user from the web page. Those commands can be displayed on the LCD display. And also by ZigBee module these commands were sent to section2. Section 2 is dedicated to control the devices. Section 2 receives the commands by the ZigBee receiver module. So the devices can be controlled by the respective commands sent by the user.

III. INTRODUCTION TO HARDWARE PARTS OF ENERGY EFFICIENT HOME AUTOMATION SYSTEM

A. Microcontroller (LPC- 2148)

LPC 2148 Micro-controllers were originally used as components in complicated process-control systems. However, because of their small size and low price, LPC 2148 Micro-controllers are now also being used in regulators for individual control loops. In several areas Micro-controllers are now outperforming their analog counterparts and are cheaper as well. The LPC21418 is a 32/16 bit microcontroller which will be operated in both arm mode and thumb mode. LPC2148 consists of 32/16 bit ARM7TDMI-S microcontroller in a tiny LQFP (Least Quad Flat Package) package, 40 kb of on-chip static RAM and 512 kb of on-chip flash program memory and it has on-chip bootloaders those are ISP (In System Programming), IAP (In Application Programming) these boot loaders are used to dump the program into the microcontroller. It has USB 2.0 Full Speed compliant Device Controller with 2 kB of endpoint RAM. LPC2148 has two 10-bit A/D converters those are AD0, AD1. Each ADC provided with 8 analog inputs, with conversion times as low as 2.44 μ s per channel. It has single 10-bit D/A converter provides variable analog output. LPC2148 has Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog timer and it has low power RTC (Real Time Clock) with an independent power and dedicated 32 kHz clock input. It has multiple serial interfaces including two UARTs (Universal Asynchronous Receiver Transmitter) those are UART0, UART1 and two Fast I2C-bus (Inter Integrated Circuit) and also consists of SPI (Serial Peripheral Interface) and SSP (Synchronous Serial Port) these are the synchronous serial protocols with buffering and variable data length capabilities. It has on chip PLL with settling time of 100 μ s and also has on-chip integrated oscillator operates with an external crystal in range from 1 MHz to 30 MHz and this external oscillator frequency will be extended up to 50 MHz. LPC2148 have Power saving modes include Idle and Power-down. And it also has Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC). LPC2148 is operated with the voltage range of 3.0 V to 3.6 V (3.3 V \pm 10 %) with 5 V tolerant I/O pads.

B. Power Supply

We have to provide power supply to the ARM controller board as 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step

downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100 μ F. Now the output from this section is fed to microcontroller board to supply operating voltage.

C. LCD

LCD is used to display the information about the current process. Liquid crystal displays (LCDs) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarisers are pasted outside the two glass panels. These polarisers would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarisers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarisers, which would result in activating/ highlighting the desired characters. The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

D. GSM Modem

The GSM modem will communicate with microcontroller using serial communication. The modem is interfaced to microcontroller using MAX 232, a serial driver. Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service. The standard is used in approx. 85 countries in the world including such locations as Europe, Japan and Australia. GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in many parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM operates in the 900MHz, 1800MHz, or 1900 MHz frequency bands. GSM has been the backbone of the phenomenal success in mobile telecoms over the last decade. Now, at the dawn of the era of

Online Data Acquisition and Controlling System Implementation Cortex M3core Based on Free RTOS

true broadband services, GSM continues to evolve to meet new demands. One of GSM's great strengths is its international roaming capability, giving consumers a seamless service.

A GSM modem can be an external modem device, such as the Wavecom FASTER Modem. Insert a GSM SIM card into this modem, and connect the modem to an available serial port on your computer. A GSM modem can be a PC Card installed in a notebook computer, such as the Nokia Card Phone. A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port on your computer. A dedicated GSM modem (external or PC Card) is usually preferable to a GSM mobile phone. This is because of some compatibility issues that can exist with mobile phones. For example, if you wish to be able to receive inbound MMS messages with your gateway, and you are using a mobile phone as your modem, you must utilize a mobile phone that does not support WAP push or MMS. This is because the mobile phone automatically processes these messages, without forwarding them via the modem interface. Similarly some mobile phones will not allow you to correctly receive SMS text messages longer than 160 bytes (known as "concatenated SMS" or "long SMS"). This is because these long messages are actually sent as separate SMS messages, and the phone attempts to reassemble the message before forwarding via the modem interface.

E. ZIGBEE

ZigBee is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide ranging controlling applications and to replace the existing non-standard technologies. It currently operates in 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps. The ZIGBEE specification is a combination of Home RF Late and the 802.15.4 specification. The specification operates in the 2.4GHz (ISM) radio band - the same band as 802.11b standard, Bluetooth, microwaves and some other devices. It is capable of connecting 255 devices per network. The specification supports data transmission rates of up to 250 Kbps at a range of up to 30 meters. ZIGBEE's technology is slower than 802.11b (11 Mbps) and Bluetooth (1 Mbps) but it consumes significantly less power. 802.15.4 (ZIGBEE) is a new standard uniquely designed for low rate wireless personal area networks. It targets low data rate, low power consumption and low cost wireless networking, and its goal is to provide a physical-layer and MAC-layer standard for such networks. Wireless networks provide advantages in deployment, cost, size and distributed intelligence when compared with wired networks. This technology allows users to set up a network quickly, and allows them to set up networks where it is impossible or inconvenient to wire cables. Wireless networks are more cost-efficient than wired networks in general. Bluetooth (802.15.1) was the first well-known wireless standard facing low data rate applications.

The effort of Bluetooth to cover more applications and provide quality of service has led to its deviation from the design goal of simplicity, which makes it expensive and inappropriate for some simple applications requiring low cost and low power consumption. These are the kind of applications this new standard is focused on. It's relevant to compare here Bluetooth and ZIGBEE, as they are sometimes seen as competitors, to show their differences and to clarify for which applications suits each of them. The data transfer capabilities are much higher in Bluetooth, which is capable of transmitting audio, graphics and pictures over small networks, and also appropriate for file transfers. ZIGBEE, on the other hand, is better suited for transmitting smaller packets over large networks; mostly static networks with many, infrequently used devices, like home automation, toys, remote controls, etc. While the performance of a Bluetooth network drops when more than 8 devices are present, ZIGBEE networks can handle 65000+ devices. Probably the main feature of ZIGBEE is its limited power requirement. ZIGBEE is better for devices where the battery is rarely replaced, as it is designed to optimize slave power requirements, and battery life can be up to 2 years with normal batteries. Bluetooth is a cable replacement for items like phones, laptop computers and headsets. Bluetooth devices expect regular charging and use a power model like a mobile phone. ZIGBEE is also outstanding when facing timing critical, low power applications. The join time for a new slave is typically 30ms, and the time needed by a slave changing from sleeping to active, or accessing the channel is typically 15ms. Bluetooth devices need 3 seconds to either join a network or to change to active from sleeping state, though they are much faster accessing the channel (around 2ms).

IV. RESULTS

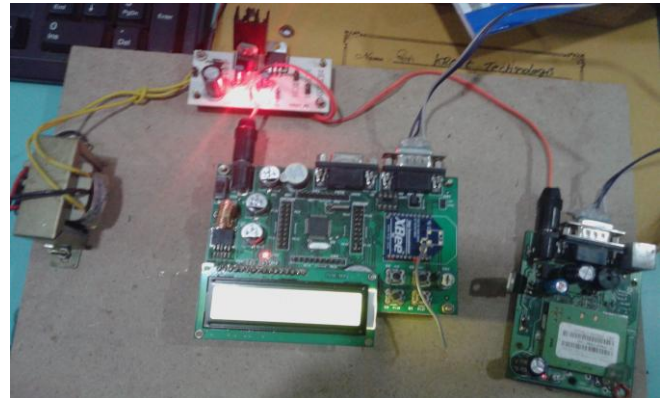


Figure3. Hardware of section1.

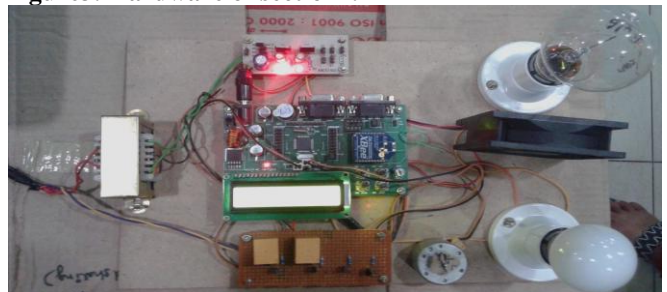


Figure4. Hardware of section2.

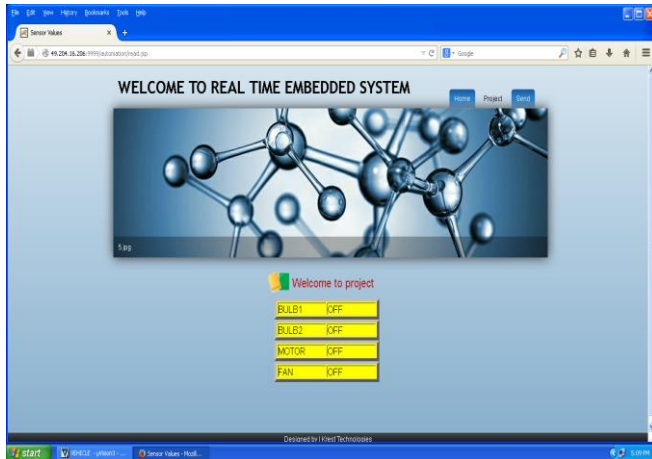


Figure5. Web page.



Figure6. Device control web page.

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V. CONCLUSIONS

This project is very useful in the view of energy saving and also it determines the security that a home must needed. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

VI. REFERENCES

- [1] Xiangyang Li, Weiqiang Zhang, and Hujing, “Design of Intelligent Home Appliance Control System based on ARM and Zigbee” IEEE 2012, 978-1-4577-3/12
- [2] Lakhya, Inder, Emanuel, Abhijit, Lalan, Debraj, and ER.M.Sujitha, “Home Automation System based on Zigbee” UARJ, ISSN: 2278-1129, Volume-I, Issue-3, 4, 2012
- [3]Soma Sudheer, B. Nageswararonaik, and Ch.Eswara Kumar, “Design and Implementation of nodes for the Agricultural Information Wireless Monitoring” ISSN: 2278-7844, 2010
- [4] QIN Tinghao, and DOU Xiaoqian, “Application of Zigbee Technology in Wireless Sensor Network”2007, pp 57-59
- [5]Kiumi Akingbehin, Akinsola Akinbehin