

Research Paper

INTELLIGENT APPLIANCE CONTROL SYSTEM USING ARM7 AND ZIGBEE

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Now a day's power control is a big problem. Because some time we just forget to switch off all the electrical home appliances which leads to power loss. So here we are presenting a paper through which we can control all the electrical home appliances. This electrical control system is based on LPC2129 ARM microcontroller, a operating system which is based on Linux and Zigbee, which will transmit the data wirelessly. In order to control the devices we have a touch screen connected with ARM. Zigbee is a new technology, which is used to transmit data with a data rate of 240 kbps and it has, low cost, safe, short range, low power consumption. Here we are giving more focus on LPC2129 because it is the main core of our system. So the overall system can be divided into two part and they are control section and devise section. Here we have a touch screen module through which user can control the home appliance and it is connected with the LPC2129 microcontroller and this microcontroller is also connected with some other devises. In the device section the Zigbee will receive the data and it will pass it to 8051 μ c.

Keywords: ARM7, Zigbee, Linux, 8051 μ c

INTRODUCTION

Intelligent information appliance is the main direction of development in the appliance control field. So this overall system can be divided into three parts namely control section, Zigbee transceiver and devise section. Now control section also called as hand held terminal uses touch screen display, Which is interfaced with LPC2129 microcontroller and have a different on-off button for controlling

different electrical appliances. Zigbee, which acts as a wireless link between the devise and control section and establish a communication path between them. Each section consists of different terminal, and each terminal is independent of other. So in the case of failure of one terminal will not affect the other one. Control section uses 32 bit RISC based ARM7 processor, since it is interfaced with touch screen, and apart from that it is also

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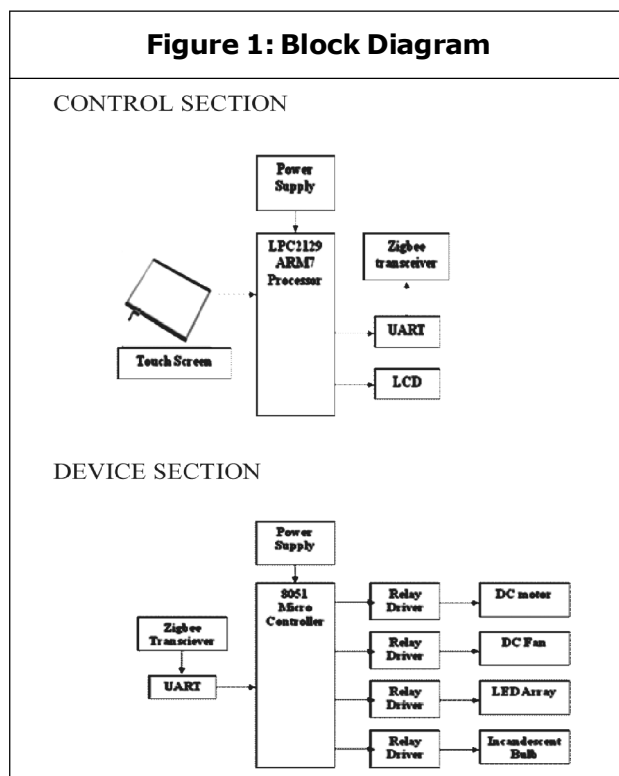
connected with a 5v DC power supply, and it has a LCD which will display the current status of the devise, that is either it is in off or on condition. Now UART will serially transmit the data to Zigbee and from there it will transfer to devise section, Then in the devise section it will get converted into TTL voltage level because Zigbee transfer the data in the form of RS232 voltage level and since all microcontrollers will accepts only TTL voltage level. And the microcontroller in the devise section is also connected with power supply, Relays, and for each devise we have a relay connected with them, since the 8051 microcontroller will get the data fromLPC2129 and based upon that it will generate the control signal and sends it to the relays. Since relays act as a remote switch and basically will switch off on the devices which is connected to it. So through this system we can control almost all the electrical devices.

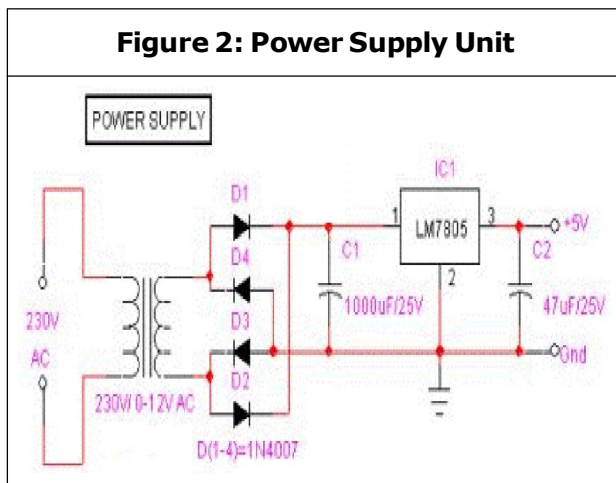
HARDWARE REQUIRMENT

- Power supply Unit
- Microcontroller Unit
- LCD
- MAX232
- Zigbee
- Driver Circuit.

Power Supply Unit

Since we need a DC power supply of +5 v for the operation of our microcontroller. But here we are giving the input as 220 v AC power supply. So we need to convert this voltage to +5 v dc. So at first we need to step down this 220 v ac supply, and in order to do that we are using a 12 v/1A step down transformer. so we are giving this 220 v ac supply to the primary of this transformer and from the secondary we will get 12 v ac current. But we need a dc power supply for the operation we for converting that 12 v ac into dc we are using precision rectifier, which will convert 12 v ac current into 12 v dc current. Since we are using precision rectifier instead of bridge rectifier because it will provide twice output as that of bridge rectifier. Then it will get filtered by the capacitor. Now we have 12 v dc supply which has got some ripples but as we mentioned above that we need +5 v dc supply. So in order to convert this 12 v into 5 v dc, we need a voltage regulator IC, And for our project we are using IC LM7805 which will convert that 12 v dc into 5 v dc and also removes the ripples. LM7805 is a three terminal voltage regulator IC in which pin first is used for input, second is grounded and from third pin we will get the required output.





Microcontroller Unit

AT89C51 Microcontroller

The AT89c51 is a 8 bit microcontroller. Here 'C' represent the way it manufactured, i.e., it stands for CMOS technology, And AT stands for its manufacturer company, i.e., Atmel. It has a 4 kb of reprogrammable memory, which can be reprogrammed by means of non volatile memory programmer. It has 128 byte RAM, four input output port, and each port consists of 8 pin and each pin can acts as input-output port. So it has got totally 32 I/O pins. It has got six interrupt sources through which any external devise can request for the service. It can operate in any one of the two mode, i.e., idle mode and power down mode for the efficient use of the controller. It will receive the data from the Zigbee module and based on the data received from it, and will generate the different control signal and send it to the driver circuit for controlling of the electrical home appliance.

LPC2129 Microcontroller

Since the controller which is interfaced with the touch screen has to be performed very complex task, that's why we are using ARM LPC2129 on that place. It is a 32 bit ARM controller which is made by ARM limited. It is

a 16/32 bit processor with real time emulation and also has the capability of trace support. It has a 128 kb of reprogrammable memory. And it can be done in three ways and they are, by means of built in JTAG, AND by means of in system programming and in system application programming. Since it uses RISC instead of CISC, Therefore it can execute faster than CISC based machines. It is a 64 pin IC and has different bit timers, different numbers of ADC, some CAN channel to connect it with outside world for data transfer, some fact GPIO line for connecting different I/O devices at a time. And also has nine interrupt pin through which external devices can request. It has three different buses which is used to, interfacing on chip memory controllers, to interface interrupt controllers, and for connection to on chip peripheral function. Here in our project when we will press any icon on the touch screen then that will produce a signal on the LPC2129. And it will pass that signal to the devise section through Zigbee transceiver.

LCD

Here we are using a LCD which is interfaced with LPC2129 and is character based LCD. And it need a controller for the working of this LCD, here in our project we are using IC HD44780, which will drive our LCD.

Here in this project the LCD will display the status of all electrical home appliances that is either it is in off or on condition. In the market one line, two line or four line LCD are there, Which can support 80 character in one line. But for our project we are using one line character based LCD. Generally LCD comes with 14 pins but sometimes it can also contain 16 pins also if the LCD does not have the back lights. It consists of three control line, 8 I/O lines.

And 8 data pin which will first convert the data in the ASCII format then only it will send it to the controller. Now the 8 data pin is connected with the 8 pin of port one of the controller AT89c51. And three more pins, i.e., RS, RW and en is also connected with the pin 5, 6, 7 of the third port of the controller AT89c51.

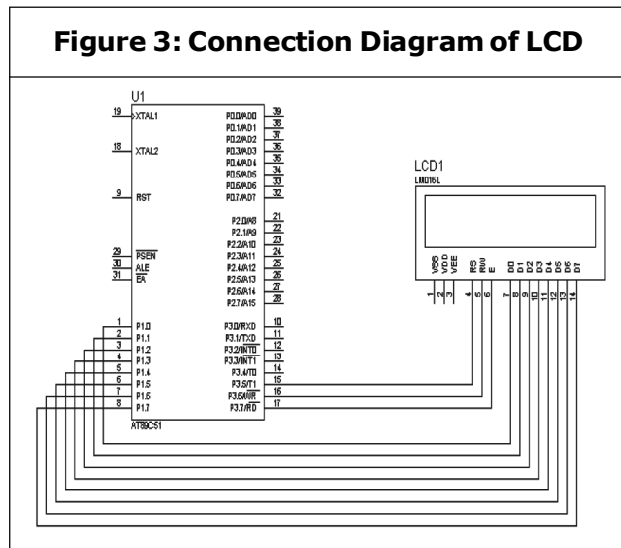


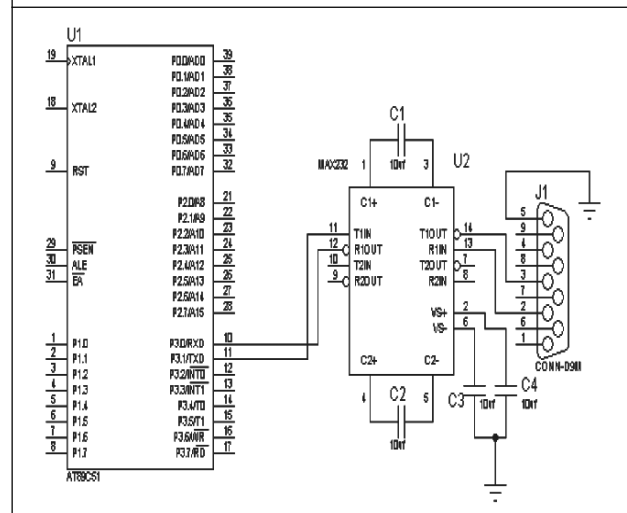
Figure 3: Connection Diagram of LCD

MAX232

We know that our microcontroller uses TTL voltage level, that is it represent '1' as '+5 v' and '0' as a '-5 v'. But in our project we are using Zigbee for the transmission of the data between the devise and control section. So Zigbee generally serially transmit the data in the form of RS232 voltage level. Since it will serially transmit the data to the devise section but the data is there in the form of RS232 voltage level and our microcontroller is not compatible with that RS232. So for converting that RS232 into TTL voltage level we are using MAX232. So we can say that it act as a converter which convert RS232 voltage level into TTL voltage level. The p3.0 and p3.1 pin of 8051 controller is connects with driver of MAX232. And T1OUT and R1OUT pin of MAX232 is connected with the next level. So

it is connected after the UART because after that only it need to be convert it into RS232 voltage level. Since after the UART only the Zigbee module is connected. But it is not a separate circuitry; it is just a wire in our project.

Figure 4: Connection Diagram of MAX232

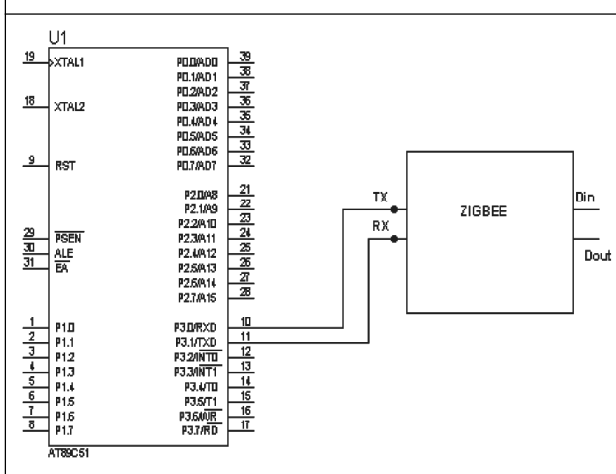


Zigbee

It is a protocol which is used for wireless transmission in the different frequency band with a different data rate in each frequency band. It serially transmits the data in the form of RS232 voltage level. Since Zigbee is a transceiver so it can used as transmitter as well as receiver. It is used worldwide in the frequency band of 2.4 GHz and in this band it provide data rate of 240 kbps, and in USA and Australia it used in the band of 915 MHz and provide data rate of 40 kbps. And in Europe it is used in the band of 868 MHz and offers the data rate of 20 kbps. And each band offers 16 numbers of fixed channels for the communication.

It need 3.3 v to 5 v and consumes very less power compare to Bluetooth. The pin number 0 and 1 of the third port of the microcontroller

Figure 5: Connection Diagram of Zigbee



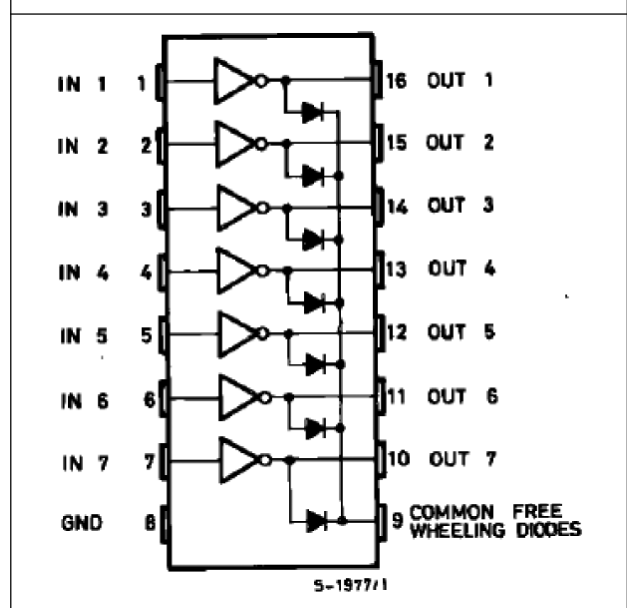
is connected with the TX and RX pin of Zigbee module. And when it need to send any data to the devise section then it will send through the Dout pin of it. And the Zigbee module which is present on the other side receives it from the Din pin of it.

Driver Circuit

In our project we need a driver circuit or relays for controlling of the all electrical home appliances. Basically relays acts as a remote switch. Which uses low voltage to control the high voltage load. So for our project we are using ULN2003 IC as a driver circuit or as a relay.

This IC consists of seven Darlington transistor array with common cathode, which is used to control the inductive loads. These transistors can also be arranged in parallel in order to get high current capability. It has a 2.7 kW of series base resistor so that it can be used as TTL compatible CMOS microcontrollers. In our project it is connected with the AT89c51 microcontroller. In order to control the electrical devices which are connected to it, and it can be present in any one of the following mode and

Figure 6: Driver IC ULN2003



they are always off condition, Or in always on condition. So based upon the signal generated from the AT89c51 it will either switch off or switch on the electrical devices which is connected to it.

APPLICATION

This project has a lot of application in the field of appliance control. By means of this we can save the power, which is being loosed now days. Since we are using a touch screen for controlling the electrical devices so it is quite easier for the user to carry this with them, and by means of wireless communication technology we can control our appliance from anywhere and at any time. So it is useful in all the places where we are using electrical appliances.

FUTURE ENHANCEMENT

Since this project is based on LPC2129 microcontroller which is interfaced with touch screen. So in future it can be that is hand held terminal can be made more compact. And

instead of Zigbee if we would work than we can use GSM module after which it would become so easy to control it from anywhere. And we can also implement this project in real time.

CONCLUSION

Since we are using ARM LPC2129 as the main controller of our project so in future if we would work than we can made it so compact. And since we are using touch screen so it is very easy to control all the electrical devise with a single touch. And due to the Zigbee technology it becomes very easy to transfer data between them. 🌀

ACKNOWLEDGMENT

I would like to thank esteemed Bharath University Department of Research and Development and also to thank Department of Electronics and Telecommunication, Chennai 73.

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