

Design of Intelligent Lighting Controller Based on ARM

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Abstract—Intelligent lighting network system was introduced, with emphasis on the design of intelligent lighting controller based on ARM microcontroller LPC2104. The lighting controller can realize lighting controlling and scenes setting and so on. And it links up with home ethernet gateway through RS-485 bus, which realizes the remote control and remote inquiry to lighting.

Key words—lighting controller; LPC2104; nRF401; RS-485 interface; remote control

1. Introduction

With the implementation of the green lighting engineering, intelligent lighting control is a very important content. Lighting not only to meet the requirements of the bright visually, but also to meet the requirements of art to create colorful imagery gives Visual enjoyment. The wide range of lighting carefully, making it the most suitable for the atmosphere of the effect is the high quality of life. At present, China's lighting control is largely manual forms, not only cumbersome and inefficient, inconsistent with the modern and comfortable standard of living. Intelligent lighting control systems to achieve significant energy saving effects as main objectives. Effective control can be extended lamp life, improve the working environment, improving lighting quality and achieve a variety of lighting effects. Therefore, the design of an easy control for lighting, while providing a scene, a remote query features such as intelligent lighting system not only has a practical value, but also has a very broad market prospect.

Current foreign intelligent lighting control systems are based on bus control technology^[1], Powerful and wide range of applications. In our more senior buildings generally includes construction equipment monitoring system, the basic lighting using DDC control. Due to construction equipment monitoring system is not designed for lighting, so it has certain limitations: (1) very difficult to achieve dimming control; (2) does not have a dedicated Control Panel, full computer control, flexibility, (3) quality requirements for watch keeping personnel. This article describes the control system has the following features: (1) wireless remote control, touch lighting control; (2) combinations of settings; scene (3) preset storage functionality; (4) remote control and query. This control system is mainly used in Office buildings and residential area of the room.

2. Intelligent lighting control system

Intelligent lighting control system consists of hanging RS-485 Bus Chi Can node — Intelligent lighting controller. Various lighting controller through RS-485 Bus and family Ethernet network terminal communication to Lighting brightness of remote control and query. System block diagram like Figure 1 shown.

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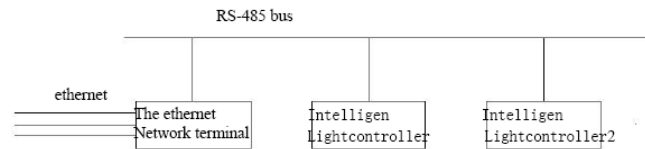


Fig.1. Networked intelligent lighting control system block diagram

3. Intelligent lighting controller hardware circuit design

3.1. Design goals

The intelligent controller provides a wireless remote control, touch lighting control, scene, mix, preset storage capabilities. Through remote control, Because LPC2104 Rich peripheral interface resources, and has a very high level of reliability and speed, so it is very suitable for the design of this product.

3.2. Hardware diagram

Intelligent lighting lighting controller schematic diagram like Figure 2 Shown.

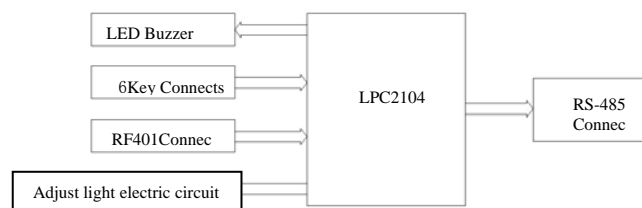


Fig.2. Intelligent lighting controller schematic diagrams

Hardware has the following parts:

- (1) SCM and its peripheral devices. Mainly LPC2104 , LED LEDs and buzzer.
- (2) Touchtone interface. In Control Panel provides 6 key button, as the dimming control or scene control.
- (3) RF401 RF interface. In the Control Panel has a RF402 RF Receiver, you can receive RF signals.
- (4) Dimming driver section. By chip contains a zero-crossing detection circuit for optical coupling drive TRIAC, achieve dimming control.
- (5) Home control network connections section. By Sipex corporation SP485E ^[3] , DB9 socket.
- (6) Power part. By 1 tablets 7805 supplied 5V DC voltage as the front-stage and upper stage power by LDO chips last stage output power circuit, 3.3V and 1.8V DC voltage.

3.3. nRF401 And LPC2104 Connection

nRF401 Wireless communication transceiver chip ^[4] In a 20 Pins of the chip integrates a high-frequency emission / Receiving, PLL Synthesis, FSK Modulation / Demodulation and features such as multi-channel switch, low-cost digital communications applications has outstanding technical advantages.

nRF401 And LPC2104 Connections have a number of options, such as GPIO , I²C , UART , Etc., from the hardware connection and the most simplified communication protocol, select serial port and is connected to the wireless module is the best option. Select UART₁ of T_XD₁ , R_XD₁ respectively and nRF401 of D_{IN} , D_{OUT} connection. NRF401 and LPC2104 interface circuit shown in Figure 3 shown.

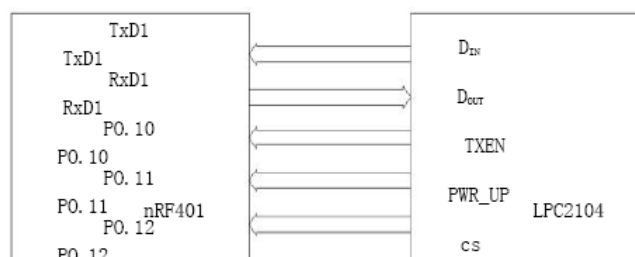


Fig.3. NRF401 and LPC2104 interface circuit

Switch; CS For channel selection, you can use GPIO Settings. You can use LPC2104 of UART₁ serial control D_{IN} , D_{OUT} signal.

To energy saving, in most cases nRF401 Should be turned off, because wireless segment on hardware that does not have auto-wakeup feature, so must the way through the software of communication protocols, to ensure energy savings without loss of data.

3.4. RS-485 Interface circuit

RS-485 Interface circuit's main function is to send a signal from the microprocessor T_x Convert through the dispatcher communications network Differential signal, or communication networks of differential signal is converted by the receiver processor receives R_x Signal. At any point, RS-485 transceiver can only work in receive or send mode. Figure 4 shown SP485E isolation. RS-485 Circuit. Connect to A pin pull-up resistor R₇, connected to B pin PORTF R₈ is used to ensure that no connection SP485E chip is idle, the provision of network failure protection, to enhance RS-485 node and network reliability. Figure 4, clamp on 6.8VTVS tube P6KE6.8CA used to protect RS-485 bus, avoid RS-485 bus from outside interference (lightning and surge) pressure damage RS-485 transceivers.

Use DC/DC Chip BO505S-1W Produce 1 Unit and microprocessor circuit complete isolation of the power output, this output is used to RS-485 Transceiver circuit provides +5V Voltage.

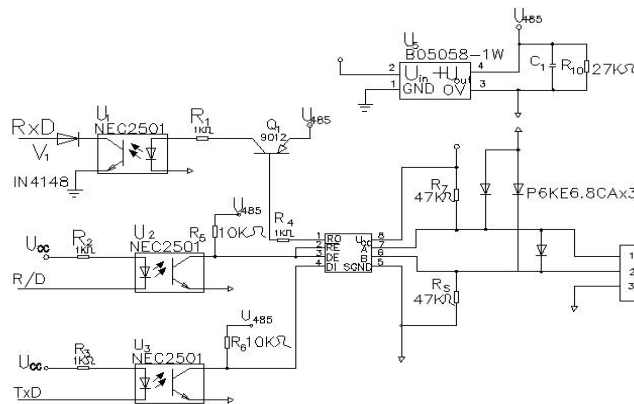


Fig.4. SP485E Isolation RS-485 Circuit

3.5. Dimming circuit

Traditional dimming method using phase-shifting trigger mode, the control SCR's angle to control the output power. Not only synchronous detection circuit complexity, but also in the moment thyristor conduction will produce higher harmonic interference caused by voltage waveform distortion, affecting other electrical devices and communication systems work properly.

Commission too zero trigger TRIAC on-and off time ratio to adjust power sent lamps. This method does not change the voltage waveform instead of changing the voltage full wave through the number of times will not cause pollution on the power grid. Dimming circuit^[5] figure 5 shown.

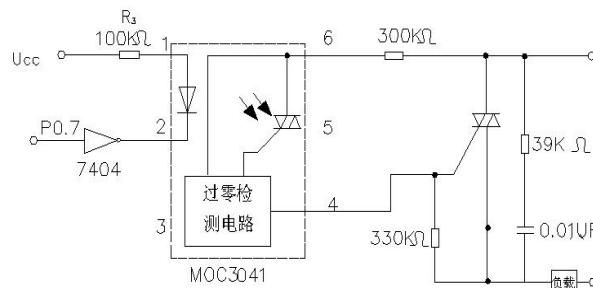


Fig.5. Dimming circuit

Adopting one-chip computer I/O Mouth filling the current methods for controlling the TRIAC switch and dimming control. Opt coupler MOC3041 as TRIAC drives, and can realize the power of isolation. MOC3041 internal circuit containing zero-crossing detection. When the input pin 1 enter 15mA current, which output pin 6, pin 4 voltage between one zero, internal TRIAC break over, triggering external TRIAC conduction. When the input pin input current for 0A when, internal TRIAC to external TRIAC is also shut off.

4. Software design

Intelligent lighting controller software consists of the main program and sub-program, the output of the program and application-layer stack, etc. Intelligent lighting controller software diagram like Figure 6 shown.

The main program and sub-program include initialization procedures, signal handlers, control procedures and renderer.

This system uses a SP485E To extend I/O Port and use LPC204 Processor DB9 To simulate IIC Agreement complete the data communication. Be the first to use VHDI hardware description language design IIC Protocol hardware circuit, and downloaded to the SP485E chip, mainly to complete the data transfer startup stop, data reception subroutine . In addition system 32 group switch quantity real-time control is achieved through this interface.

Application-layer program including switch panel buttons, radio frequency remote control to accept the pre-set scene store, dimmer thyristor control capability.

Use LPC204 A GPIO Mouth to achieve wireless module work patterns and sleep state transitions.

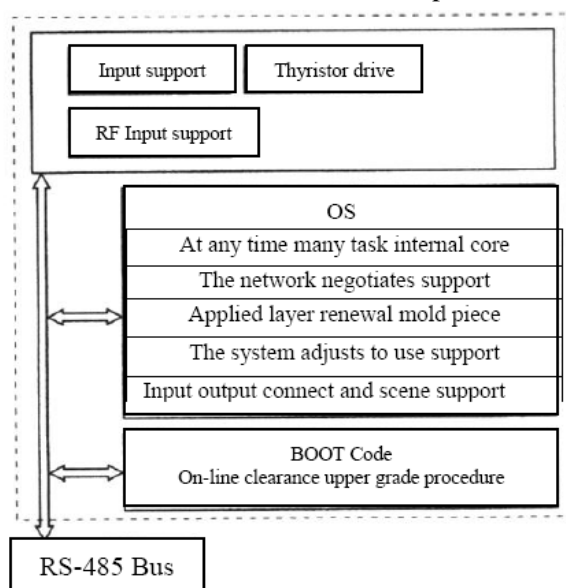


Fig.6 The intelligence light controller software frame diagram

5. Knot Language

This system uses embedded microcontroller LPC2104 It provides 32 Than available I/O . Because it has a wide range of serial communication interface and chip up 64KB of SRAM , multiple 32bit timer, PWM output and 32 a GPIO , especially useful in the design of intelligent lighting controller. The intelligent lighting controller through RS-485 interface is very easy to network for the realization of intelligent home networking.

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