

# Remote Intellectualized Regulate and Control to LED Luminaire Based on PWM

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**Abstract:** (Objective) In order to control dimming light set by remote intelligent and is easily operated, the integration adjustment system of color and brightness can be set up on the PWM. (Methods) The whole system is mainly composed of mobile client and system control terminal. The mobile client is interface of user. The system control terminal mainly adopts modular structure including power supply module, software module and control module. The application software has three operation interfaces to find, operate and control equipment. (Results) LED control can be regulated through intelligent terminal software to complete basic operations such as turning on/ off the lights, dimming, and security setting. LED indicator can be adjusted by using PWM, and the color temperature can be adjusted by the proportion of the tricolor collocation. Wi-Fi module can try to connect by phone transmission. The result of examination is that the basic parameters, such as network name and password, can modify on the mobile devices after the connection is successful. (Conclusion) IOT manage software can choose interface of MCU module to realize data input and output operations, to realize adjustment of the LED brightness, to realize adjustment color temperature on the tricolor LED.

## 1. Introduction

Along with our country has made an achievement in the high speed economy, communication technology and computer network technology development, the intelligent lighting as an important part of digital home is no longer a high-end product. All kinds of technology development companies (IBM, Microsoft, Haier, Samsung, Panasonic, Siemens, etc.) pay more attention to practical design. International brands, such as Dynalite, WIELAND, gradually enter our country market, not only to accelerate the development of products, also to let wisdom lighting to ordinary family. In recent years, domestic intelligent lighting manufacturers and businesses (TsingHua TongFang, Super, Dozens, Haier, etc.), have sprung up rapidly. It can be predicted that the intelligent lighting will gradually replace the simple lighting, open the imaginary space to custom life and environment.

## 2. Technical Summary

### 2.1. WiFi and wireless network

The main advantage of WiFi (short for Wireless Fidelity) is that doesn't need wiring, don't be restricted by condition. WiFi can fit the needs of users on the mobile Internet, it has broad market prospects. From the traditional business process, information management services and other fields, WiFi has expand to more industry, even into the family life control, mobile applications and other fields [1]. Its high transmission speed can be up to 600 Mbps. Its effective communication distance is very long. In the open area, distance can reach more than 300 meters. In the closed area,

communication distance can reach more than 100 meters. WiFi can integrate conveniently with existing Ethernet networks with low cost and good reliability. Aiming at the limitations of traditional WLAN communication, by increasing the bandwidth or transfer rate, WiFi has achieved a wide range of intelligent control and overcome the bottleneck.

As general wireless network base is equipped with wireless network card and AP, WiFi network structure can be divided into ad-hoc network topology structure and infrastructure topologies. If a few computer peer-to-peer networks don't need AP, only every computer equipped with a wireless network card. After the wireless mode pass Callback, these computer will share network resources, extend applications and intelligent control.

## 2.2. PWM module

Dimmer mode that is used mainly has pulse width modulation (PWM) dimming, silicon controlled dimmer and analog dimming at present. Although three methods can all achieve the dimming effect, but it has different on the specific implementation process and reliability [2]. PWM dimming principle that is similar to the pulse width modulation wave is a very effective technology to control analog circuits using of the microprocessor digital output.

It is widely used in measurement, communications, power control and transform in many areas. It usually consists of a column different duty cycle of rectangular pulse. The duty cycle is proportional to the instantaneous sample values of signal. The modulation joins commonly to external PWM dimming signal module and acts on the power driven DIM pin to achieve control of the LED brightness.

## 3. Control System Design

It is necessary to establish a set of dimming method provided with energy saved, high efficiency and simple operation. On the premise, WiFi designed as intelligent lighting system can realize to turn on/off the lights, it can increase the adjustment function to mild light color brightness. To dim LED light, the energy consumption will be smaller. Dimmer rises to beautify the environment and customize effects. The intelligent lighting becomes more simply, more human nature after WiFi communication realized reliably remote adjustment.

The whole system is mainly composed of mobile client and system control terminal. Among them, the mobile client is the user's interface, to control the switch lighting and color temperature adjustment through mobile intelligent terminal software. On the one hand, System control terminal is used to realize the basic operation of LED lights, such as lights, turn off the lights, dimmer, password changes, etc., to get all sorts of color using the WiFi dimmer work of the tricolor LED lights, and to implement the proportion of the adjustment of the color temperature. On the other hand, the WiFi devices can modify functions on the basic parameters such as network name and password.

### 3.1. Hardware module

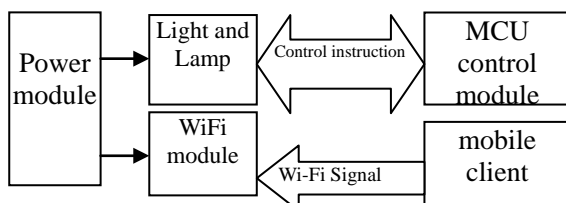


Figure 1. the work flow chart of the module structure

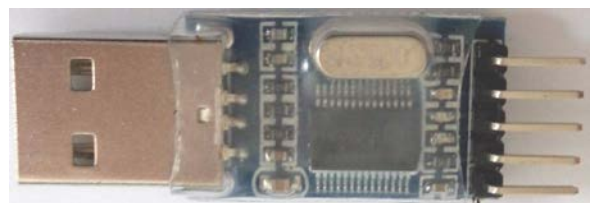


Figure 2. diagram on USB transfer to low voltage

WiFi smart lighting Adopted the module structure design has advantageous for the organization and function area, mainly including power supply module, WiFi module and MCU control module, as shown in Fig. 1.

The switch mode power supply module provided power for luminaires and lanterns separate

supply WiFi module and MCU control module of low voltage. For general and convenient interface, connected USB port can supply 3.3 V / 5 V dc voltages, as shown in Fig. 2, in order to meet the requirements two kinds of voltage of different devices. For stable performance, power supply products can be designed independently to provide voltage. MCU control module is mainly deal with mobile phone terminal to send the control command, to realize the connection and control of the Wi-Fi module.



Figure 3. physical image of the WiFi module

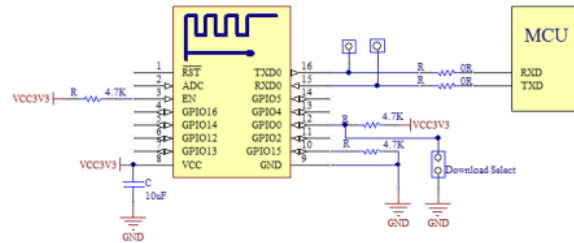


Figure 4. circuit connection diagrams

ESP8266 is WiFi network solutions to provide completely and self-contained, especially design for mobile devices and the Internet application, it can run independently, can also be run for the slave carried on other Host. The ESP8266-12 chip Designed as WiFi module, object as shown in Fig. 3.

The user's physical devices connected to a wifi to run Internet or LAN communications, and to realize Internet function with the ultra-low power consumption. The characteristics of the ESP8266-12 chip have a built-in frequency 160 MHZ, 32-bit MCU which is configured as 32 mbit application processor. It has the large capacity FLASH and 250 k RAM. It can support wireless 802.11 b/g/n standard, support three work modes (STA, AP and STA+AP). It has Built-in TCP/IP protocol stack to support multiple TCP Client connection, to support rich the Socket of the AT command, to supports UART, SPI, IIC, SDIO, GPIO data communication interface, to support three intelligent connection(ESP Touch, AI Link and Airkiss). The meanings of each pin refer to ESP8266 instruction[3].

Main control functions of ESP8266 include serial pass-through, PWM control, and GPIO control. The serial pass-through is reliable data transmission; the biggest transfer rate is 460800 BPS. The PWM can control implement lights, three color LED adjustment, motor speed 1. The GPIO can control switch, relay, etc. ESP8266 modules need peripheral devices including 10 resistance capacitance inductance, passive crystals, and a flash. Operating temperature range is - 40 ~ 125 °C. Circuit connection diagram shows as Fig. 4.

### 3.2. Software modules

MCU control module mainly deals with mobile phone terminal to send and control instruction. Software implementation of Wi-Fi module can transfer remote signal to achieve wireless transmission and control. Independent 8 bit or 32 bit chips are recommended, such as STC15F2K60S2 chips. Using the low-cost microcontroller STC15W201-SOP8 as the main control device, system made the NMOS with low turn-on voltage drive to achieve dimming and toning[4]. For example, code program as follows.

```
#include<STC15F2K60S2.h>
#include"intrins.h"
#include"string.h"
#define uchar unsigned char
#define uint unsigned int
uchar PWM_counter=0;
void PWM_init(void){ }
void UartInit(void){ }
void WiFiInit (void){ }
void main(){
```

```

PWM_init();
UartInit();
  WiFiInit();
Delay1ms(200);
While(1)
{ ..... }
void ser-interrupt {
  if(RI)
  {
    RI=0;
    EA=0;
    date[x]=SBUF;
    x++;
    if(x>=20)x=0;
    EA=1;  }
}

```

The exclusive APP software matched the Wi-Fi module controller is adopted, IOT Manage software is downloaded in the mobile terminal [5].these software realizes interface on the Wi-Fi module and a mobile phone signal. It is the key to realize intelligent control of Wi-Fi when it can get the communication function of the Wi-Fi module or send data to the Wi-Fi module. As I/O output interface on the Wi-Fi, the function of software is three main operation interfaces. The find equipment interfaces mainly connect with Wi-Fi module. The configuration equipment interfaces realize the encryption of Wi-Fi system. The control equipment interfaces divide into LED light-dimmer and switch.LED dimming has three I/O control and nine I/O port switch.

### 3.3. Adjust LED lights base on the WiFi module

Through GPIOA1, GPIOA2, GPIOA3 three control ports, the software can control current of the tricolor LED lights to realize control of the LED color temperature. As shown in the table 1. There are the three states of the control port and the feedback of command.

Table 1. Commands corresponding control port

GPIOA0	GPIO A2	GPIOA3	
1	X	X	SDIO/SPI WIFI
0	0	1	UART Download
0	1	1	Flash BOOT

There are operation interface for the control port as below. All tricolors LED state is bright, so color is white now. Light environment will produce light and color changes when GPIOA1, GPIOA2, GPIOA3 are pulled down. To pull only CPI012, the color of the tricolor LED lights will turn red and green light is reduced until to 0, the color of the LED lights is purple. To Pull only GPIOA2, the color of the tricolor LED lights will turn yellow, blue light gradually disappear until to 0, at this time the color of the LED lights is yellow. To only pull GPIOA1, the color of the tricolor LED lights will turn green, and red light gradually disappear until to 0, at this time the color of the LED lights is navy.So the software can realize to turn on/off the LED luminaire and control color temperature through wireless.

## 4. Conclusions

Wi-Fi module of luminaires launch signal when it is connected successfully by mobile phones. Management software program control the Wi-Fi module to realize regulation of color temperature, brightness and switch state on the tricolor LED luminaire.

Wi-Fi module may disconnect the server response over 12 meters. Reason is: the effect of Wi-Fi transmitter itself, Wi-Fi emission signal is affected by the route of transmission such as walls, people, and troubles at Wi-Fi hardware itself. So it is necessary to improve in the intelligent lighting control system. For example, adjustment of the color temperature is not precise enough, Wi-Fi

module in the design has not better play a role, Wi-Fi password is not strong enough, and the product has not been applied in a large lighting system.

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