CapSpeaker Reproducing Guide

1 Hardware

Prepare the hardware of CapSpeaker using the following instructions.

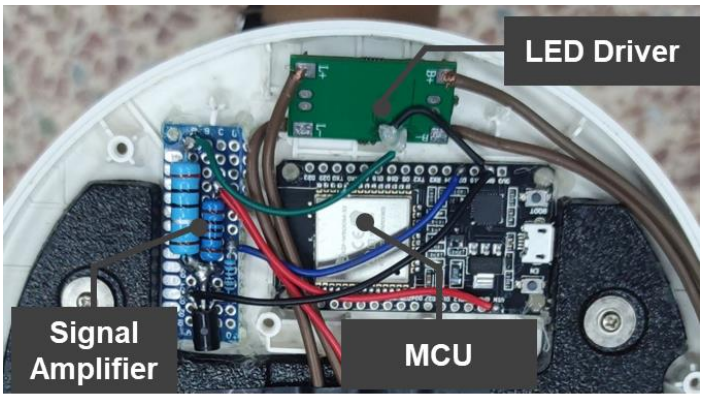

Figure 1: The internal circuit diagram of the Mi LED Desk Lamp 1S after replacing the MCU board

1.1 LED Driver Board

LED Driver Board Link:：

https://item.taobao.com/item.htm?spm=a1z09.2.0.0.28a12e8d8q5MJQ&id=569108322725&_u=41mqrhb61ce9

Figure 2: The LED Driver Board

Tips (not necessary): The original inductor may produce sound that interferes the sound generated by capacitors. It is better to replace the original inductor with a metallic integral molding inductor. The link of the inductor is:

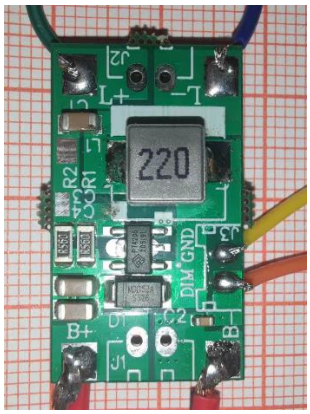

Figure 3: The LED Driver Board with replaced inductor

https://detail.tmall.com/item.htm?id=601516459097&spm=a1z09.2.0.0.28a12e8d8q5MJQ&_u=41mqrhb64a5f&skuId=4206349845511

1.2 MCU Board

Link:

https://detail.tmall.com/item.htm?id=571150226991&spm=a1z09.2.0.0.28a12e8d8q5MJQ&_u=41mqrhb65dd7&skuId=4448624935668

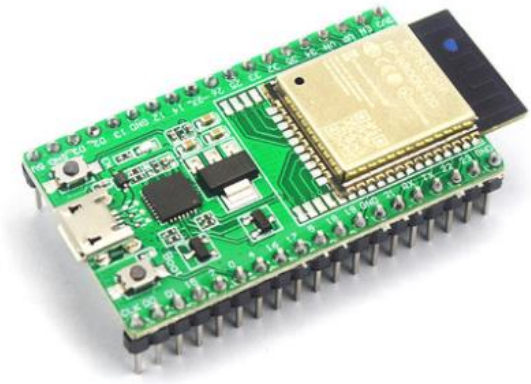

Figure 4: The MCU Board

1.3 LEDs

1.3.1 Commercial Lamp

Using Mi LED Desk Lamp 1S

Tips: there are two set of LEDs in the Mi LED Desk Lamp 1S. The two set of LEDs need to be

connected in series.

1.3.2 Self-implemented Lamp (Optional)

Link:

https://item.taobao.com/item.htm?spm=a1z09.2.0.0.28a12e8d8q5MJQ&id=627338634883&_u=41mqrhb67460

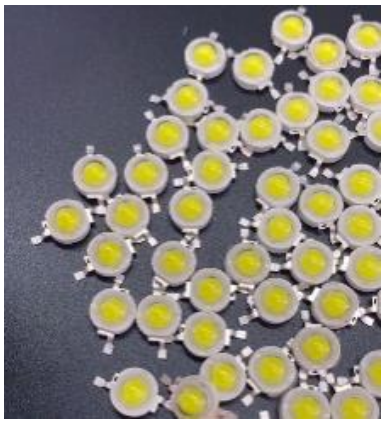

Figure 5 LEDs

1.4 Amplifier Circuit

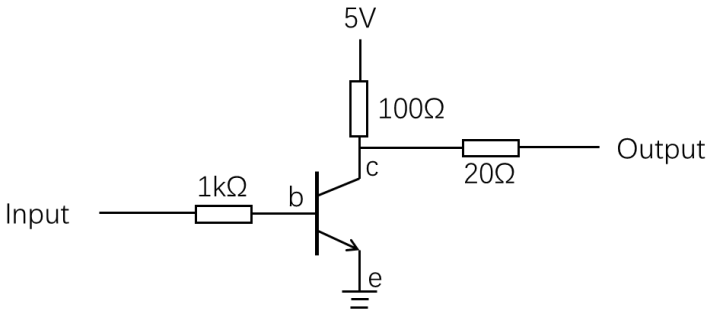

Figure 6: Amplifier circuit

Triode link:

https://detail.tmall.com/item.htm?id=14679332057&spm=a1z09.2.0.0.28a12e8d8q5MJQ&_u=41mqrhb644e4

Figure 7: Triode

1.5 Power Supply

Voltage: 48 V;
Current: higher than 0.5 A
Tips (not necessary): It is better to increase the resistance on the positive output wire of the power supply to increase the change in capacitor voltage. This can be done by using a long and thin wire or add a small resistor connected in series in the wire.

2 Software

1. **Prepare the voice command "wav" file.** The "wav" files we used are in folder "voice_command".
2. **Generate PWM duty cycle traces using "generate_capspeaker_duty_traces.m".** The default carrier frequency is set to 32 kHz.
3. **Copy the duty cycle traces to "dutyArray.h".** The default carrier frequency is set to 32 kHz.
4. **Set the PWM output pin and Carrier Frequency in "GPIOctrl.c".** The default carrier frequency is set to 32 kHz, and the default PWM output pin is set to pin 5.
5. **Burn "dutyArray.h" and "GPIOctrl.c" to the ESP-WROOM-32D MCU.** Please refer to the document of ESP-WROOM-32D. Link: https://docs.espressif.com/projects/esp-idf/zh_CN/latest/esp32/api-reference/peripherals/ledc.html#_CPPv421ledc_channel_config_t