Design of an Intelligent Acousto-optic Dual Control Lamp

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Abstract: At present, acousto-optic dual control lamp are widely used in public places such as schools, companies, and residential buildings. However, once the initial delay is fixed, it is difficult to adjust and cannot respond flexibly to various situations. With the development of science and technology, the demand for high-quality public facilities is growing. Public lighting facilities must develop in the direction of intelligentization and humanization. In this paper, a new intelligent sound control lamp is proposed. The speech recognition chip is used in the sound control lamp. The delay control of the lamp is realized by recognizing the speech command, which makes the system more intelligent and has market application value.

1. Introduction

Acoustic and optical dual control lamp is a lighting device integrating acoustic and optical technology. It is energy-saving, environmentally friendly, safe and reliable[1]. At present, the sound control sensitivity of the common acousto-optic dual control lamp is 60 decibels in China, and the sound intensity when people speak loudly is about 55-65 decibels. The sound control effect is that the light is on when the sound intensity is greater than 60 decibels, and the light is automatically turned off after 30 seconds.. It not only increases the life of the lamp, but also successfully solves the trouble of finding the switch in black, and effectively avoids the waste of resources.

However, once the initial delay of the widely used acousto-optic dual control lamps is fixed, it is difficult to adjust and cannot respond flexibly to various situations. For example, if you go out and throw garbage for a few seconds, the light will be wasted for 30 seconds. If you accidentally drop small objects, it takes more than 30s to pick things up, so you must trigger the sound control lamp again. The intelligent sound control lamp designed by this subject is to add the speech recognition function based on the dual control function of sound and light. The light-on time controlled by the user's speech command can cope with various situations and improve the efficiency and intelligence of the lighting facility. The degree is more energy-saving, environmentally friendly and convenient for life.

2. Design of the System

Design an intelligent sound control lamp with acousto-optic dual control and speech recognition. Among them, the function of the acousto-optic dual control is that the lamp will not light when the ambient light is sufficient. only after the ambient light is dimmed, the light will automatically illuminate when there is sound, and the illumination will be automatically turned off after 10 seconds delay.The function of speech recognition realizes that the user issues the speech instruction, the speech recognition system recognizes the keyword, and controls the light time through the single chip microcomputer.

This design synthesizes the use of sensor technology, speech recognition technology and single-chip microcomputer technology to achieve the overall function of intelligent sound control lamp. The system hardware is composed of single chip microcomputer, various sensors, light driver, language recognition system and other modules. According to the characteristics of external environment information such as light and sound, the photoresistor and electret sound

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sensors are used to collect light and sound respectively, and the collected signals are transformed into digital signals by reasonable circuit design. Single-chip computer receiving and processing digital signal through the light driver control lamp lighting and lighting time. The single chip computer realizes various sensor information collection, analysis and lighting control functions. Figure 1 is the overall working composition diagram of the system.

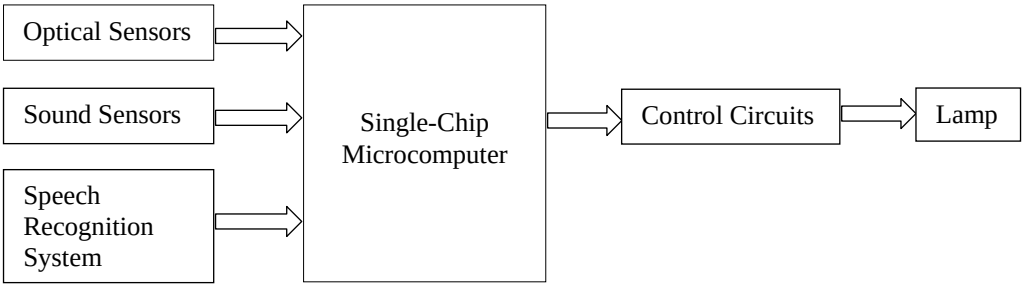


Figure 1. System work composition

Sound control circuit: The use of the electret microphone to convert the collected speech signal into electrical signal, so as to push the trigger to work, and finally realize the circuit guide.

Optical control circuit: when the brightness of the photoresistor changes, the photoresistor will also change, the change in the size of the resistance can control the strength of the electrical signal, so as to control whether the circuit is conductive.

Speech recognition system: After the speech recognition part detects the user's speech instruction, the speech recognition chip transfers the processed data to the main controller, the main controller sends the processed command information to the MCU, and the single-chip microcomputer control lamp changes the light time according to the speech instruction[2].

When the light is bright, the brightness of the outside is converted into a corresponding voltage value by a photoresistor, and then the corresponding digital signal is input to the single-chip microcomputer after comparison by the voltage comparator. When the light dims, the load circuit detects the sound coming from. The force microphone is used to convert the sound signal into an electrical signal, thus pushing the trigger to work. When the sound intensity reaches a certain level when the light is lit, after a pre-set delay time, the lamp will be automatically extinguished. Use the timer inside the MCU to control the length of the delay time. When the user's speech enters the speech recognition system, the speech recognition chip sends the processed data to the single chip computer for processing, and after the single chip microcomputer is processed, the command data is sent to the external illumination circuit to control the duration of the light[3].

3. Hardware design

3.1 Acoustic and Optical Dual Control Circuit

The sound emitted by the sound source is converted into an electrical signal by a acoustic electric converter, and the electrical signal is amplified and transmitted to the processing circuit, which is then filtered to convert the sound signal into the signal we need[4]. After the treated acoustic photoelectric signal input MCU, when the light is brighter, the light control part will automatically turn off the switch, the sound control part does not work. When the light is darker than the set brightness, the light control part automatically turns on the switch, and the sound control part controls the load circuit. The sound intensity determines whether the line is connected. When the sound reaches the set strength, the switch can be switched on automatically, the lamp is automatically lit, and after 10s delay, the line is automatically disconnected, waiting for the next trigger. The principle is shown in Figure 2.

Fig. 3 is the circuit diagram of the sound signal acquisition circuit. Its main components are voltage comparator LM339, potentiometer, Electret microphone. The output signal of the sound control circuit is transmitted to the P2.3 port of 51 single chip microcomputer.

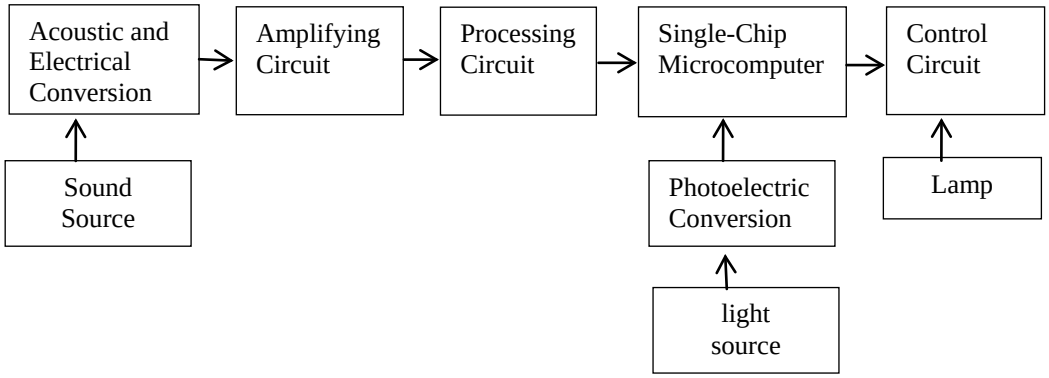
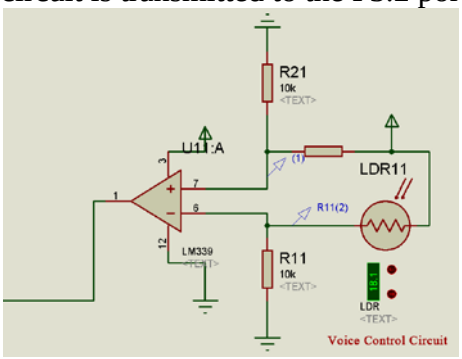


Figure 2. Acoustic and optical dual control principle block diagram

The circuit diagram of the optical signal acquisition circuits is shown in Figure 4. Its main components are voltage comparator LM339, potentiometer, Photoresistor. The resistance value of the photoresistor is to change the resistance value with the change of the irradiated light, and when the irradiation light is strong, the resistance value of the photoresistor will become smaller, and when the irradiation light is weak, the resistance value of the photoresistor will increase. Photoresistor is the photoelectric effect of using semiconductors. The output signal of the optical control circuit is transmitted to the P3.2 port of 51 single chip microcomputer.



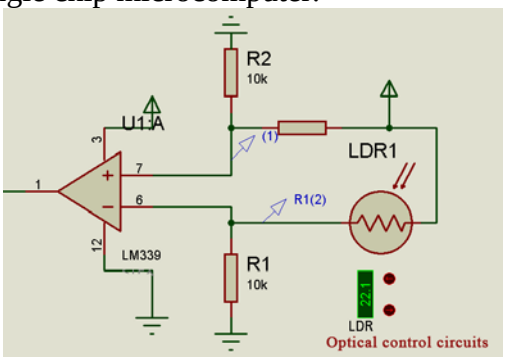


Figure 3. Sound signal acquisition circuit diagram Figure 4. Optical signal acquisition circuit diagram

3.2 Speech Recognition System

The speech recognition scheme of this topic is based on embedded microprocessor, and the peripheral plus LD3320 speech recognition chip. Speech recognition Chip LD3320 uses ASR technology to create a way to get rid of switches, remote controls and other operating methods, making intelligent sound control lamp system operation is simpler, more flexible and convenient[5]. The LD3320 chip has two modes, which are divided into trigger recognition mode and Circular recognition mode for users to use. By programming the chip, you can set up two different operating modes. The PIN name and function of speech recognition chip are introduced in detail in table 1.

TABLE 1. Speech recognition chip pin description.

Pin Name	Functional Description	Note
MUT	Play Sound when Low Level	Mute Control
ADK	Button	Multiple sets of ADK keys
VCC	Power Input	3.3V-5.4V
RXD	UART Serial Data Input	TTL Level
TXD	UART Serial Data Output	TTL Level
GND	Ground	Power Ground
SP+	Positive Amplifier Output	Speaker Output
SP-	Negative Amplifier Output	Speaker Output

4. Software Design

4.1 Design of the Main Program

In the program design of Intelligent sound control lamp, the initial setting of each part should be carried out first. The delay program is initialized and the speech recognition module is initialized. If the light intensity is strong, the system is initializing the state all the time. When the light intensity is reduced to the set value, the system begins to collect sound signals. When the system does not capture the sound signal, the system returns to the initialization state. When the system collects the sound signal, the light is lit and the delay program is activated, with a delay of 10s. At this point, the speech recognition module begins to work, if there is no speech instruction, the light lights up 10s automatically extinguished, back to the initialization state waiting for the next trigger. If there is a speech instruction, then follow the speech instruction to control the light time. For example, if the user issues a 60s speech instruction, continue to light 60s and then go off after the light is on 10s, and then return to the initialization state to wait for the next trigger. The flowchart is shown in Figure 5.

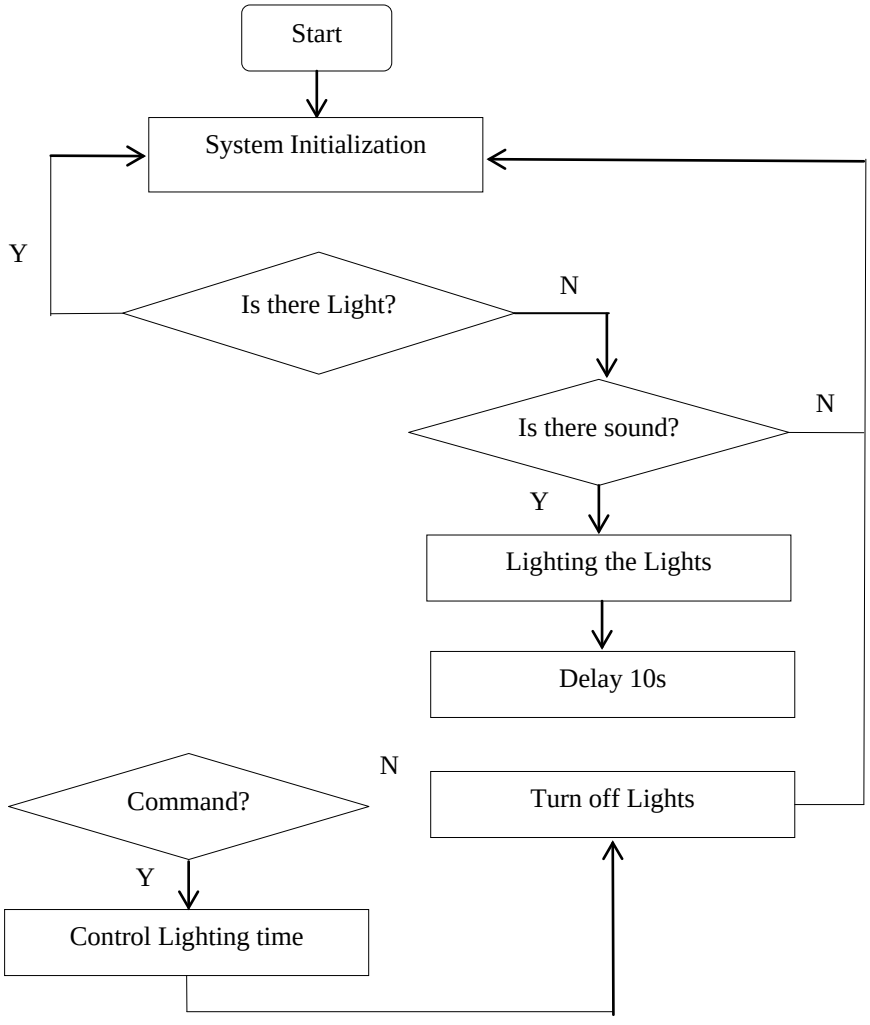


Figure 5. Main program Flowchart

4.2 Speech Recognition System Program

The order in which speech recognition operates is as follows. First, initialize the speech recognition system. Second, write into the recognition list. Third, the speech recognition feature is started. IV, the interrupt response function is started, and the interrupt allows the bit to start working. Among them, the identification list has the following provisions. First, each recognition entry has a corresponding number of bytes, and for different recognition entries there can be a number that is

not continuous but can be the same. Second, LD3320 can have 50 identification entries, which must consist of lowercase chinese pinyin, each of which must be separated by a space[6]. This topic needs to LD3320 identify 30s,50s and 60s and other entries.

The ADC channel is the electret microphone input channel, and the ADC gain is the standing pole microphone volume. The larger the value set by the ADC, the larger the volume of the electret microphone, the faster the recognition starts, but the inevitable will lead to a lot of false recognition. Similarly, the smaller the value the ADC sets, the smaller the mic volume, which requires close speech to start the recognition system, with the advantage of being unaffected by distant speech interference[7].

5. Conclusion

This paper uses single-chip microcomputer technology, combined with sensor and LD3320 speech recognition chip, to complete the overall structure of intelligent sound control lamp, the main controller and acoustic optical control system, speech recognition module hardware and software design.

The experimental results show that the average recognition rate of speech command can reach 90%, and the light time test of intelligent sound control lamp is completed, and a good experimental effect is achieved. This intelligent sound control system has the characteristics of small volume, low power consumption and can be universal, so it has a wide application prospect.

There are still some problems in this subject that need to be improved. First, how to correctly sense the environmental information around the smart lamp. Second, how to ensure the normal operation of the system, the appropriate reduction of the system's power consumption. Third, how the speech recognition application developed is applied to the intelligent control platform.

In the subsequent application of intelligent sound control lamp needs to be further excavated, but also the intelligent sound control lamp post-processing further improvement.

Acknowledgments

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