Light Control Lock Based on Micro-programmed Control Unit System

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Abstract

This paper designs a kind of light control lock. It includes the locks, the electromagnetic valve control, optical signal receiver and MCU controller. When we use the light control lock, the app mobile phone software will control the camera flash light signal in phone or optical signal transmitted by infrared remote control transmitter. Encrypted optical signal will be received by optical signal encryption in light control lock and the optical signal will be decoded by MCU. If the optical signal is accordance with the preset encryption method, the signal chip control solenoid valve to open the door. Experimental results show that the design of electric door lock has good effects. It has a high success rate to unlock by using a mobile phone and can be used in the actual application.

Keywords

MCU; app; Light controlled lock.

1. Introduction

Maslow's hierarchy of needs theory is one of the theories of behavior science. The theory of human needs is divided into a ladder from the low to high levels of five species, and the second is the security needs. Exquisite poetry lock in Qing Dynasty with password has the function of locking, protecting the information security in order to form a specific combination of rotating swivel of the lock nose. However, in the rapid development of science and technology, it is a common topic to improve the safety of property and personal information security. The researches of using technology to unlock make much progress constantly. Card type cipher lock can be opened by the IC cards, which operation is simple. However, the interference of the magnetic object may weaken the ability to unlock. The fingerprint lock has high intensity of confidentiality. The humidity of the opponent is strict and the position of the finger is also rigid. Even putting the same finger, if the input is not the same as before, it may be identified failure. The paper is based on the design of a new type of optical lock chip. Through the design of the application of mobile phone, the lock terminal of the photoelectric cell phone will identify the flash and the internal microcontroller will achieve the matching process. This kind of method combines with the characteristics and the advantages of light flash by controlling the number of locks. As the mobile phone can be easy to carry, it has wide prospect of development.

2. Integrated Design

The light controlled lock is divided into two parts of key and lock. The key terminal is composed of intelligent terminal and optical A terminal. A terminal is the main control communication terminal and the intelligent terminal can control the A terminal, such as the key to the door. Lock terminal is composed of single chip microcomputer and B optical terminal. Optical B terminal is equal to communication terminal. When the user passes the operation information to the door lock, the door will receive the information in external door lock. MCU will process the information and change control of electromagnetic door lock[1].

2.1 The Design Process

Unlock signal modulated by phone flash will be sent to the single chip to electromagnetic unlock as shown in Figure 1. MCU control the mechanical drive device to door lock, and it needs to preset electromagnetic passwords. The design develops optical communication serial port software. In the software, it can alter the passwords into the light signal to control flash lights, and the software can dynamically encrypt the input passwords. Under the condition of the reference signal for the mobile phone of the lock signal, it needs to synchronize the phone time with single chip microcomputer clock strictly. The secret key information will be updated when the door unlocks each time. At the same time, the old secret key information loses efficacy. This kind of lock can solve the "Key Stolen" problem, which greatly improves the safety of the lock. The photoelectric triode set in the electromagnetic lock collects the signals of flash light, taking UART protocol as the communication way to pass the unlock passwords. I/O port signal in single chip microcomputer will execute decode instruction and passwords comparison by program. If the comparison is right, the changes of output level in MCU will control the mechanical drive device and open the door[2].
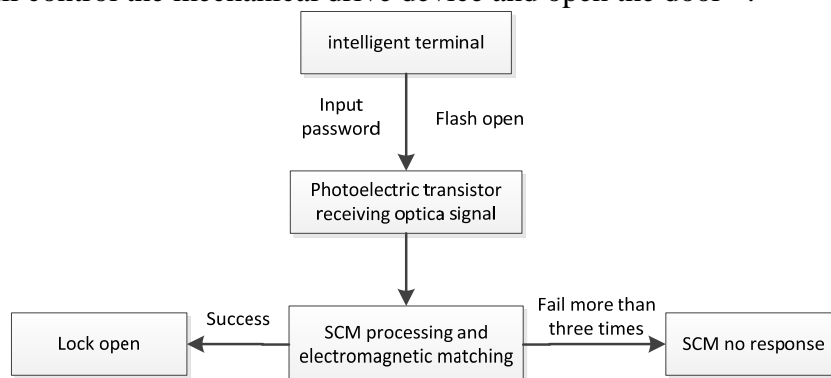

Figure 1 Integrated Design Process

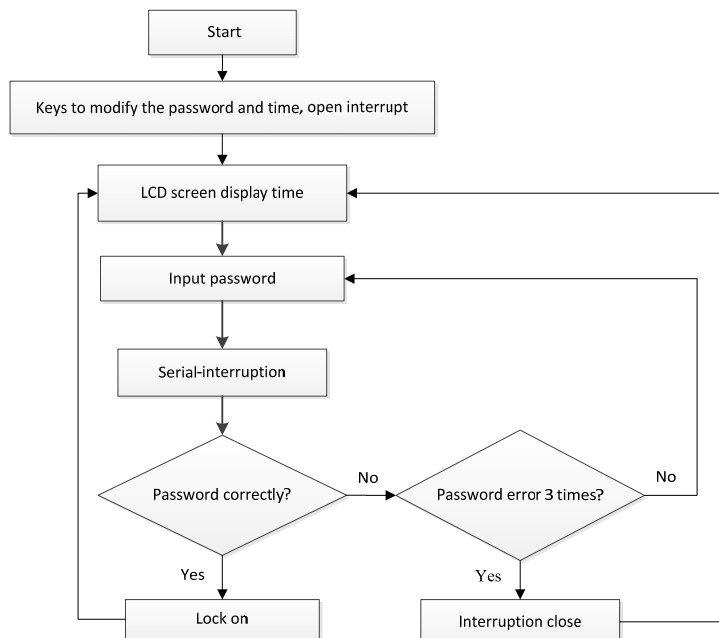## 2.2 The APP of Mobile Phone Design

Figure 2　Mobile app Flow Chart

We design a kind of mobile phone application software. The mobile phone will flash after typing six passwords. Photoelectric triode in lock terminal will receive signal and conduct electromagnetic matching in the internal of STM32F103C8. If the match is right, the door will open. It designs to use dynamic encryption technology to input six passwords as shown in Figure 2. When we enter the

password, the serial port will be interrupted. If the passwords are right, the lock will open. If the passwords are wrong, we should input repeatedly. When the failure exceeds three times, the interruption will close. In this situation, although we input passwords again, the lock will not respond, which also guarantees the security of the lock[3].

We click on the electric lock after entering application. Click the start button and input six passwords, click "send". Meanwhile, mobile phone flashes and sends the light information of "on" or "off".

3. Design Features

As using the key to unlock the door, we also can use the flash in the mobile phone to unlock. This method can solve the problem of key lost. By using the technology of dynamic encryption, the lock will automatically change the security code in the key to enhance the security of the system when the door is open. In this technique, it will achieve the purpose of a key to open the number of doors through a light main terminal with multiple light terminals. The door switch is controlled achieves the web browser login control and it greatly facilitates people's lives.

3.1 Encryption Algorithm

The most critical point is how to use app software to convert ten bits codes into flash light information. This kind of software can also be used to enter the password for dynamic encryption. The reference signal is the clock signal. When we use the lock and set a password, we should make synchronous adjustment of the clock and mobile clock of the signal chip microcomputer. Then ten bit password is saved in the form of an array, a= [1 2 3 4 5 6 0 0 0 0]. If the phone time is 10:43 in November 8, 2014, then b= [1 4 1 1 0 8 1 0 4 3]. The data needs to send is c= [2 6 4 5 5 14 1 0 4 3]. This group of data is represented by 8 bits, using UART protocol as communication mode[4].

The idle level is usually high, as shown in Figure 3. The starting position is 0, and the stop position is 1. If we send data such as c [0], the binary representation is 0000 0010. The real transmission is 1001 0000 001. The flash performance for the light is : on off off on off off off off off on. The baud rate is 1200 rad/s. The duration of each state is 1/12000s. In this way, a byte has been sent. 10 bytes unlock data will be transmitted continuously. We need to judge the data ends and add the frame head and frame tail. In any case, the data in the array c will not exceed 18. So we take 19 as the frame head and 20 as the end of the frame. The send data chain is {19, c[0], c[1], c[2], c[3], c[4], c[6], c[7], c[5], 20}. The total bytes are 12. To send a lock signal only needs 0.1 seconds.
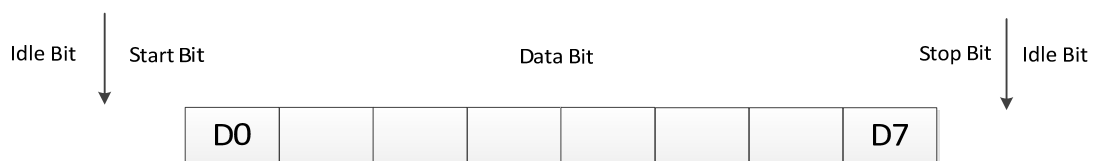

Figure 3 Algorithm Encryption

3.2 Perfection of Design Process

In the design process, we focus on testing whether the phone flash can correctly deliver the password information and whether the photoelectric transistor can accurately accept password information. However, due to the interference of external factors and internal system, the success rate of unlock process will be affected.

If the light intensity of the lock is small, it is required to increase the sensitivity of the Finel lens at the end of the lock.

In the different performance of the mobile phone, the application software for the flash control is different. In the control process, we should adjust the level of the flash in order to adapt the different types of the mobile phones for flash control. Door lock network control has some limitations. We need connect to the same router in the network to achieve the control of the lock, which the flow and the external network cannot control. In order to improve the network control procedures, we should add data exchange and link between different gateway devices. In this way, different network environment can control the door lock.

The light signal is easily influenced by external light, and it is necessary to avoid this factor. In the single chip progress operation, it should reduce the high level of the threshold and make the photoelectric transistor not sensitive to light.

4. The Development Trend of Analysis

Infrared Remote Control Electronic Password Lock. Infrared remote sensing refers to the sensor working band limited to the infrared brand range of remote sensing, which detection range is generally between 0.76-1000 microns[5]. Infrared remote sensing technology is one of the most popular research trends presently. Through infrared and wavelength, we can get the other systems in this range of induction. Through the communication of signal sending and receiving, it can complete specific functions and the effective realization of unlock.

5. Conclusion

By using STM32 microcontroller to achieve the design of light controlled door lock, it realized the function of opening the door through the intelligent mobile phone dynamic password input. The application is strong and overcome the poor security of mechanical door lock switch. Moreover, intelligent mobile phone is portable, which has dynamic encryption key information and good safety. We also need to pay attention that the light controlled locks are electronic products, which device is bound to be influenced by the environment and other external factors, caused by the damage of the components. In the realization of the lock function, the need to further improve the stability of the system is to improve the success rate of the lock.

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