Research and Implementation of Electric Bicycle Anti-Theft System

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Abstract. Electric bicycles are energy-saving, environment-friendly, lightweight, labour-saving, fast and reliable, and can meet the requirements of national energy-saving and emission reduction policies and scientific development concept. They are the first choice for consumers to travel in cities. The phenomenon of theft and loss is becoming more and more serious. Improving the anti-theft system of electric vehicles on the market has become an urgent livelihood and social problem to be solved. This paper mainly uses STC89C52 MCU as the main control chip to design an anti-theft system for electric bicycle. It realizes the functions of two-way vibration detection, sound and light alarm, mobile phone short message alarm, GSM short message remote power cut and short message remote control. The system has low power consumption, stable performance, low cost and wide application prospects.

1. Introduction
With the improvement of living standards and the reconstruction of urban roads, the scope of people's activities has increased and the distance to work has become longer. People begin to put forward higher requirements for transportation vehicles. In order to make bicycles adapt to long-distance cycling and reduce the consumption of physical energy, people have greatly upgraded bicycles and increased bicycles. The electric bicycle has been transformed from storage battery, engine and other electronic devices. Due to the increasing pressure of energy and environment on people, in order to protect the environment, the government has issued many new policies of energy saving and emission reduction, which has led to the ban of motorcycles in cities, and further brought new development space for electric bicycles. As an upgraded bicycle with electricity as its energy source, it has the characteristics of energy-saving, environmental protection, lightweight, labor-saving, fast and reliable. It fills the demand of people for travel agent tools, which can protect the environment and is convenient and fast. It has become the best choice for office workers and household short-distance travel tools, and is becoming more and more popular with consumers.

At present, China has become the world's largest producer of electric bicycles. The anti-theft system of electric bicycle is an industry accompanied by the emergence of the electric bicycle at the historic moment. Because the manufacturer does not disclose the circuit schematic diagram and related information to the public in the production and production, the books and materials for systematically introducing the production and maintenance of the anti-theft system of electric bicycle are very scarce on the market at present, which results in the electric self-operation at home and The development of
car anti-theft system is slow. In recent decades, with the rapid development of electric bicycle industry and electronic technology, the anti-theft system of electric bicycle has risen. In order to cope with the current situation of the increasingly serious theft of electric bicycle, people continue to study and optimize the existing anti-theft system of electric bicycle, so as to make its function more powerful.

In order to solve the problem of theft of electric bicycle as soon as possible, this paper designs an anti-theft system of electric bicycle with reliable performance, preferential price and many functions. Its significance is to reduce the economic losses of users, but also indirectly play a positive role in improving the natural environment and public security environment, has a certain practical value and social value.

2. Design of System Project
The overall design of the system is mainly composed of acousto-optic alarm module, wireless remote control transmitting module, wireless receiving and coding module, vibration detection module, relay power off module, GSM short message module and so on. The overall scheme design block diagram is shown in Fig.1. Its working principle is that the owner uses wireless remote control transmitting module or GSM short message module to set the system state to the state of defence. When the anti-theft system is in the state of defence, the vibration sensor senses the vibration signal, which will be transmitted to the single chip computer. The single chip microcomputer will analyse and process the obtained signal, and give the acousto-optic alarm mode. Block output a signal, trigger acousto-optic alarm, and send a signal to GSM short message module to remind the owner. The owner can send a short message to MCU by using GSM wireless communication module, and then make MCU output a high level to the relay power-off module for remote power-off operation.

![Figure 1. Block diagram of overall scheme design of the system.](image)

3. Hardware Circuit Design

3.1. Hardware Circuit Design
According to the system requirements, after demonstration and analysis, STC89C52 is used in the main control part of the system, which has larger storage space and more timers. It is easy to realize system functions, low power consumption and high cost performance. SC2262/2272 chip is selected as the encoding and decoding chip to realize the function of encoding the wireless remote control transmitting signal according to the specific mode of the encoding chip, and the decoding chip matched with it is decoded according to the specific mode. The paired decoding and coding module ensures the uniqueness
of the remote control circuit. The wireless transceiver module uses 315M module to transmit and receive system status signals. A capacitive high-sensitivity vibration sensor SW-18010P is selected as the vibration sensor. When the internal spring is subjected to a certain intensity of external force, such as collision or movement, it will cause vibration, and the conductive pin will be instantaneously turned on, so as to achieve the purpose of vibration detection. Its 360-degree working characteristics without dead angle trigger are improved. System sensitivity. GSM short message module is the module of this system to complete the sending and receiving of short messages. SIM900A module is selected as the core component of this module. SIM900A module is a high-performance GSM/GPRS module. It is programmed regularly and easy to use. It uses MICRO card holder. It has stronger quality and is suitable for compact product design. Its main functions are short message sending and receiving, language calling, and GPRS network data sending and receiving, MMS sending and receiving. It fully meets the technical requirements of the system design.

3.2. Introduction of Core Circuit

3.2.1. Minimum System of Single Chip Microcomputer. The main control function of the whole system is the STC89C52 single-chip computer, which can operate first need to build the smallest system of single-chip computer, and then need to add other peripheral circuits to achieve more functions. The minimum system of single-chip computer includes three parts: single-chip computer, reset circuit and clock circuit. The minimum system of single-chip computer is shown in Figure 3.1. When the power supply voltage works in the range of 4-5.5V, the normal operation of the single chip computer system can be guaranteed. The system uses DC power plug and socket to connect USB. The reset circuit makes the CPU of the single chip computer and the relevant parts of the system in a definite initial state, and starts to work from this state. In the design of this system, the reset circuit used is manual and power-on reset circuit. This reset circuit can reset both manually and by power-on reset, which is convenient for us to carry out manual reset of single-chip computer system. The connection modes of clock circuits can be divided into internal and external clock modes. Internal oscillation mode: the internal self-excited oscillator is formed by connecting the amplifier with the crystal oscillator. External oscillation mode: introducing external clock signal into MCU. The circuit connection is shown in Figure 2. The 18 pins (XTAL2) and 19 pins (XTAL1) of the single chip computer connect a quartz crystal oscillator and two capacitors, and together with the internal oscillator circuit of the chip, a stable self-excited oscillator is formed to control the rhythm of the single chip computer.

![Figure 2. Design of minimum system circuit for single chip microcomputer.](image-url)
3.2.2. *Wireless Remote Control Transmitter Module Circuit.* The internal connection circuit of the wireless remote control transmitter module is shown in Fig.3. It mainly consists of keys, diodes, resistors, coding chips and wireless transmitter modules etc. The coding module is based on SC2262 chip, and the wireless transmitting module is based on 315M wireless transmitting module. The circuit principle of this module is that when one of the K2, K3 and K4 keys is pressed, a signal will be transmitted to the D port of SC2262 through the circuit, which will make the encoding chip SC2262 work electrically, and then the chip will immediately send a signal to the 315M wireless transmission module. The function of the four pull-down resistors in this circuit is to avoid the confusion of the signal transmitted to the encoding chip SC2262 when the key is pressed. Diodes tightly connected to pull-down resistors act as a reverse cut-off for current. If the K2 button is pressed, the current will flow through the diode to SC2262 and the transmitter module respectively to make it electrified, otherwise, it will not.

![Figure 3. Wireless remote control transmitter module circuit.](image)

3.2.3. *Wireless Receiving and Decoding Circuit.* The internal connection circuit of the wireless receiving and decoding circuit is shown in Fig.4. This part of the circuit corresponds to the 315M wireless code transmitting module in the wireless remote control transmitting module circuit. The circuit is mainly composed of 315M wireless receiving module, SC2272 decoding module, transistors and so on. The model of decoding chip is SC2272. The circuit mainly relies on the wireless receiving module to get the signal and then transmit it to the decoding module. If the key K2 is pressed, the receiving module receives the signal and then transmits it to the decoding module. The corresponding D2 (12 feet) outputs a signal. At this time, the transistor is turned on, and the I/O port connected by the single chip computer and the module will get a signal. The 15 and 16 legs of the decoding chip SC2272 are also connected with an oscillating resistance, which corresponds to the resistance value of the oscillating resistance of SC2262. There is also a pull-down resistance connected with the triode and the single chip computer. This pull-down resistance has two functions in the circuit. The first is that when the triode is not on, the main function of the pull-down resistance is to give the single chip computer a low level. The second function is that when the transistor is on, the pull-down resistance mainly acts as a current limiting protection circuit, while the transistor acts as a switch in the circuit. Triodes and pull-down resistors in other parts of the circuit play the same role.

4. **Software Design Process**

The software part of the system is designed in C51 language under the development environment of KeiluVision4. The flow chart of the system design reflects the relationship between the module and the module. As shown in Fig.5, the idea of the whole program design can be clearly understood. First, the required data is initialized, then the system is set up as a defensive state, and then whether there is a signal is detected by the vibration sensor. If there is, the sound and light alarm will be activated, and
through GS. M module sends short messages to the owner, the owner replies to the short message to control the remote power cut; if not, the vibration sensor will continue to detect.

![Decoding circuit of wireless receiving module.](image)

**Figure 4.** Decoding circuit of wireless receiving module.

![Flow chart of system design.](image)

**Figure 5.** Flow chart of system design.

5. **System Testing**

The software and hardware of the anti-theft system of electric bicycle are debugged successfully. The results of short message test of mobile phone verify that the system can work normally and reliably. Firstly, put SIM card in SIM900A module, turn on the power supply, and wait for the signal indicator of SIM900A module to change from one second to three seconds to ensure the normal communication. Firstly, put SIM card in SIM900A module, turn on the power supply, and wait for the signal indicator of SIM900A module to change from one second to three seconds to ensure the normal communication. Then through the wireless remote control transmitting switch press the cloth protection button or mobile phone short message to send the cloth protection status, touch the vibration sensor lightly, make it get a vibration signal, trigger the sound and light alarm after 30 seconds, and send the information of "vehicle
is abnormal, please pay attention" to the vehicle. The owner only needs to turn on the mobile phone. Short message function can be viewed. When receiving "abnormal vehicle, please note", the owner can reply to the "off 1" short message, the relay in the main control module will simulate the power switch cut off, and the relay will immediately simulate the connection of the power supply when replying to the "on 1" short message. The owner can also reply to the "withdraw" short message and remotely revoke the alert status. The anti-theft system of the electric bicycle has been tested many times, and the technical indicators meet the requirements of the system design.

6. Conclusion
This paper designs an anti-theft system of electric bicycle with reliable performance, preferential price and many functions, and completes the practical anti-theft function and the function of mobile phone control system. Its significance is to reduce the economic losses of users, but also indirectly play a positive role in improving the natural environment and public security environment, has a certain practical value and social value.

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