The intelligent security system based on the public switch telephone network

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Abstract 一 **This paper elaborates the design and development of the intelligent security system based on the public switch telephone network. The system includes two parts: security detection emission, and radio reception and signal process connected to the phone line with the telephone set at home or in the office. The core of radio reception and signal process is Micro Control Unit, which, in coordination with other peripheral circuits such as telephone line interface, signaling tone detection, dual tone multi-frequency (DTMF) reception and emission, and voice notification, informs the subscriber of the alarm via voice through Public Switch Telephone Network (PSTN). In addition, the subscriber can easily modify telephone numbers stored in the system.**

*Keywords*一*intelligent control；environment monitor；security monitor*

1   Introduction

With the continued economic development, increasingly faster work pace and the imbalanced economic growth, it is more frequently than ever before that more people work from one place to another, which constitutes a huge challenge to the security administration of community environments. Furthermore, the uneven distribution of social wealth, the huge gap between the poor and the rich, and the untimely handled psychological problems and human conflicts all bring about big risks to the security work. To the improved criminal means, the traditional security measures like iron windows and iron doors are not effective. On the other hand, iron windows and iron doors present barriers to the escape from fire and risks of falling. In recent years, there have appeared new technology and products for security, which tend to be intelligent, digital and video gadgets. However, a complete set of such devices are usually high priced and are not made for the family. The under-mentioned intelligent system based on the Public Switch Telephone Network (PSTN) enjoys the advantages of low price and module design, and therefore can meet

the demands of families. The system will automatically call the telephone number stored in it through the PSTN in case of warnings and   report them to the subscriber in time via voice. Meanwhile, the subscriber can easily modify telephone numbers stored in the system.

2   The structure of the system

The intelligent security system based on the PSTN described in this paper is shown in Figure 1, which includes two parts: secure detection emission, and radio reception and signal process.

(b)   Radio reception and signal process

(a)   security   detection ession
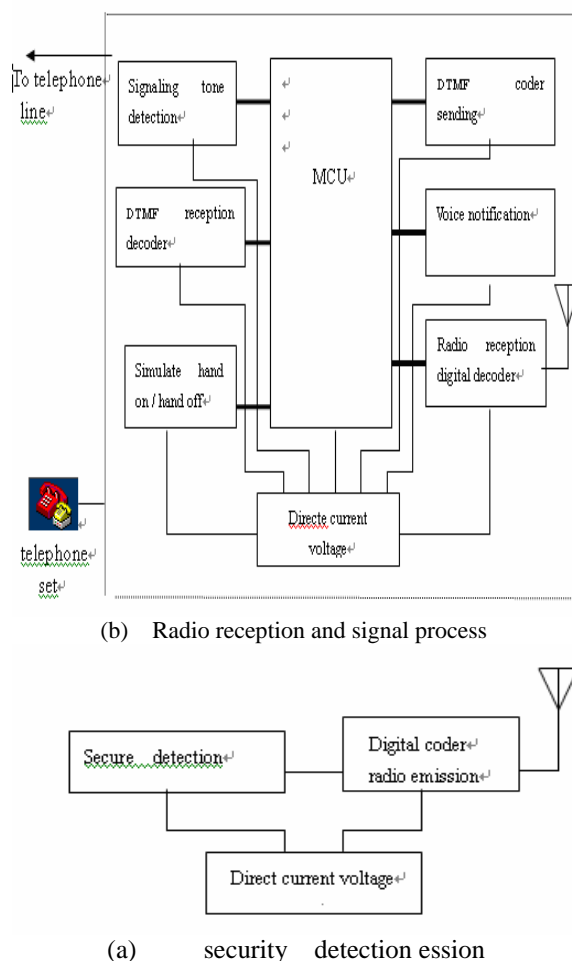
Fig. 1   The structure of intelligent security system

The part of the security detection emission is shown in Fig. 1 (a), which has three functions: sensor circuit for detecting the environment security information; digital coder for identifying the different destinations; modulation emission for modulating the output of digital coder. The sensor will produce alarm signal and flip flop digital coder once it detects the invader or other unsafe information, and the output of digital coder is modulated to amplitude shift keying (ASK).

The sensor circuit used in system is a model circuit including Fresnel lens, whose appearance is shown in Fig. 2 and parameter in table Ⅰ.
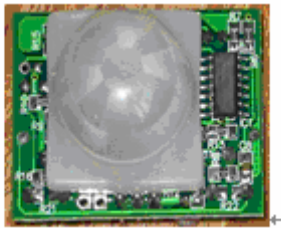

Fig. 2   The appearance of sensor circuit

TABLE I.   THE PARAMETER OF SENSOR MODEL CIRCUIT

size （millimeter） mm*mm*mm	Operation voltage （direct current voltage) Volt	Output voltage (Volt）	Distance (meter)	Sense angle （horizontd) degree	Sense angle （vertical) degree
28 * 38*25	6~9	6~9	0.5~15	90~140	15~30

The digital coder, PT2262 is produced by Priston corporation, which is a remote control coder paired with digital decoder PT2272 utilizing Complementary Metal Oxide Semiconductor (CMOS) technology and which encodes data and address pins into a serial coded waveform suitable for Radio Frequency (RF) modulation with a maximum of 12 bits of tri-state address pins and providing up to 531,441 address codes. Thereby, the coder can drastically reduce any code collision and unauthorized code scanning possibilities.

Fig. 3   The appearance of radio emission

Radio emission is a radio model, with operation voltage from 3 volt to 12 volt and its appearance and

parameter are shown in Fig. 3 and table Ⅱ respectively.

TABLE II.   THE PARAMETER OF RADIO EMISSION

Modulat-ion	Operation frequency Mega Hertz	Opera-tion voltage Volt	Emission power (milli-watt)	size (millime-ter)
ASK	315	3~12	<500	22*22*8

The distance radio signal transmitted differs with operation voltage and surroundings such as open and indoor areas.

The function of Fig. 1 (b) is radio reception, digital decoder and automatic call. Connected to the telephone line with the telephone set at home or in the office and assisted by other periphery module circuits such as telephone line interface, radio reception and decoder, Dual Tone Multi-Frequency (DTMF) emission and reception, and voice notification., This circuit in this part implements the function of receiving and processing alarm signals and automatic dialing.

Micro Controller Unit is AT89C52, which has the advantages of low cost, flexible production, high reliability, wider operation temperature, flexible structure, short design-development period. It has been used widely in industry automation, intelligent devices and electronic civil products.

The radio reception is a super regenerative detector, whose appearance is shown in Fig. 4 and parameter in table Ⅲ.

Fig. 4   The appearance of radio reception

TABLE III.   THE PARAMETER OF SUPER REGENERATIVE DETECTOR

Modulat-ion	Operation frequency Mega Hertz	Opera-tion voltage Volt	Output voltage level	size (millime-ter)
ASK	315	3~12	Transistor-Transistor Logic (TTL)	30*33*8

After being demodulated, the output of demodulator is the input of the digital decoder. The digital decoder is PT2272, which is used along with the digital coder PT2262 in emission. The output of the digital decoder PT2272 is processed by other parts.

The telephone line interface provides the function of satisfying the standard demand of the telecom device. The signal tone detector identifies the difference of the signal tones according to their special features so as to transform from one state to another. Dual Tone Multi-Frequency (DTMF) emission tone generator is designed for MCU interface, which can be instructed by a MCU to generate 16 dual tones or 8 single tones from DTMF pin. The HT9200A provides a serial mode interface for various applications such as security systems, home automation, remote control through the telephone line, the communication system.

DTMF reception is used to receive the DTMF signal sent from the subscriber. The subscriber can modify the telephone numbers stored in the system online under the control of the MCU. The voice notification provides the voice alarm information and some operation information to the subscriber via Public Switch Telephone Network (PSTN), which applies the APR9600 produced by APLUS the integrated circuit company. This single-chip voice recording and playback device offers true single-chip voice recording, non-volatile storage and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs, which integrate the output amplifier, microphone amplifier, and automatic gain control (AGC) circuits and greatly simplify the system design, ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

3   The principle of the system

The alarm system will flip flop the digital coder and modulator when the sensor detects the invader information. The information will be sent via digital coder and modulator. The radio signal is received by the radio reception and digital decoder, and the output of digital decoder will be processed by MCU. When receiving the alarm information, the MCU simulates

hand operation and sends the telephone number stored in the system via the DTMF emission when detecting the dial tone. When the subscriber picks up the receiver, the voice notification APR9600 will play the voice alarm to the subscriber via the telephone line interface and the telephone line under the control of MCU so as to inform the subscriber of the alarm. When subscriber hangs off, the MCU simulates the hand operation, which fulfills the function of automatic dialing and alarm notification. Besides, the system will provide the subscriber with the function of modifying the telephone numbers stored in the system by DTMF reception.

4   Soft flow chart

The main program flow chart is shown in fig. 5, the interrupt service program 1 flow chart in Fig. 6 and the interrupt service program 2 flow chart in Fig. 7.
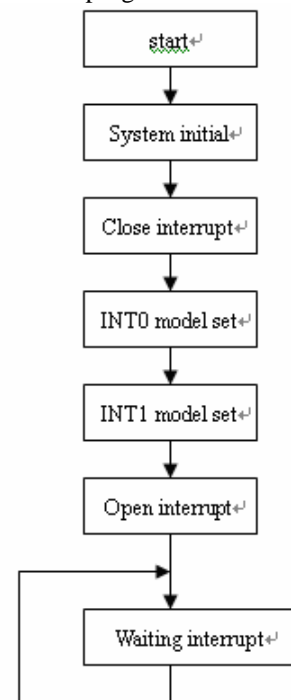

Fig. 5   The main program flow chart

The interrupt service program 1 is used for implementing the automatic dialing in case of the alarm signal and the interrupt service program 2 for modifying the telephone numbers stored in the system.
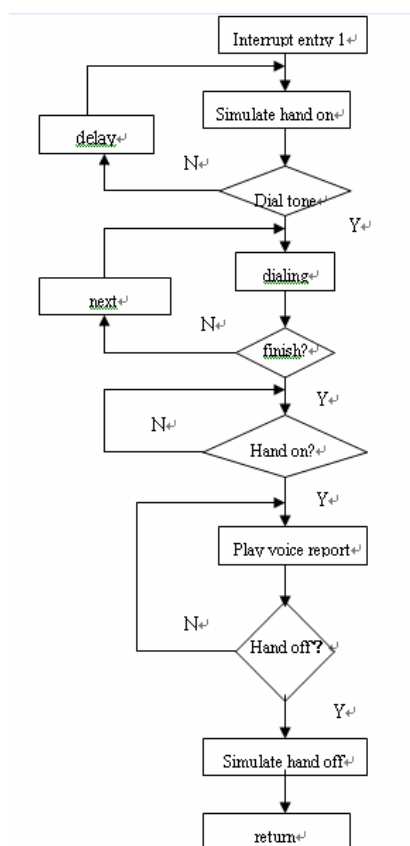
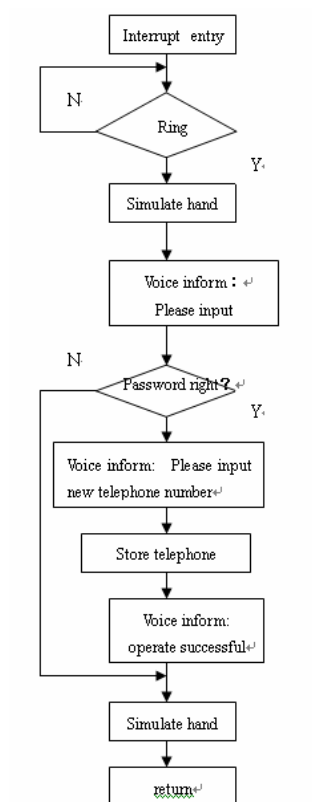**Fig. 6**   Interrupt service program 1 flow chart

Fig. 7   interrupt service program 2 flow chart

5   Conclusions

With the MCU as the core and designed and developed mainly with large scale integrated circuits, the system is characterized by the advantages of high reliability, low cost, small volume, low power consumption and easy installation, which justify the wide use of the system at home and in the office.

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