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Design of a Class of Security Systems Imitating Human Presence in the Guarded Object*

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Introduction

The security systems imitating human presence in the guarded object are a specific class since they create misleading impression in the external observer. This effect is achieved by automatic switching on and off of radio sets, radio cassette-phones, VCR and TV sets, electric lamps, etc. It is supposed that this circumstance would eventually refuse the thief from forcing the house. The idea is not new but its achievement is different and this is the paper subject. The author believes that the problem with uncontrollable robbery is socially significant and that is why he hopes to contribute to its solution representing the detail principal electronic schemes of three security systems (different in possibilities and complexity).

The author has not any pretensions so he offers absolutely free the use of the principal electric schemes of the security systems by those who are interested.

Description of security systems block-schemes

Fig. 1 shows the block-scheme of a security system with fixed switching on and off time intervals. The alteration of the intervals is accomplished before the system start, if necessary, with the help of Switch 1 and Switch 2 blocks.

The system operation is as follows: rectangular pulses with frequency of 1 Hz are obtained from the tact generator (RC Ocsillator), which are entered to two bi-input counters (Counter 1 and Counter 2). The two counters (Counter 1 and Coun-ter 2) are reset at system start and the output level of Switch 1 is null, that is why the pulses enter the counting input of Counter 1 only. After its content reaches a definite value, the level of Switch 1 becomes unit, thus blocking the counter input of Counter 1 and enabling the counter input of Counter 2; thus realizing switching in the control relay

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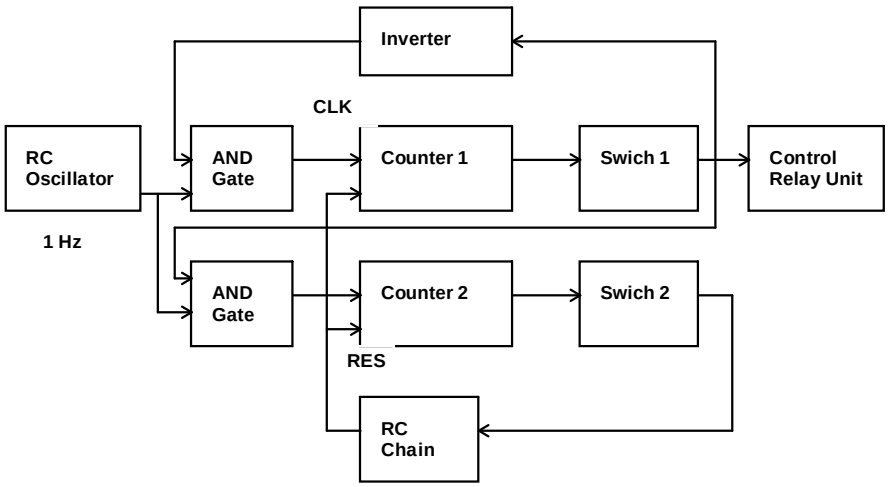

Fig. 1

unit. When the content of Counter 2 reaches a given value, set by Switch 2, the two counters are reset by a RC circuit, the relay unit is switched and the process is automatically repeated until the power supply is off.

When designing the system, special attention is paid to the circumstance that the electric lamps must not be switched on during daytime. For this purpose a special block is suggested (Control Electric Lamp), which controls them. It is analogous to the control relay unit, which produces a control signal, the difference being the presence of a sensor reacting to the visible part of the light spectrum. During daytime the sensor is activated and the control signal is blocked, so the electric lamps controlled by the Control Electric Lamp are switched off. The sensor is mounted outside the object taking precautions not to be influenced by artificial light sources, such as street lighting, for example.

Fig. 2 shows the block scheme of a security system with automatic pseudo-random alteration of the switching on and off intervals in the operation process.

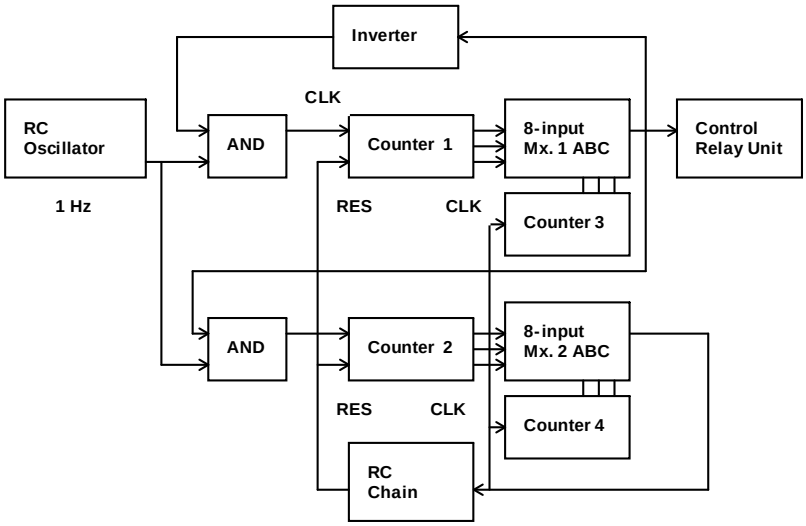

Fig. 2

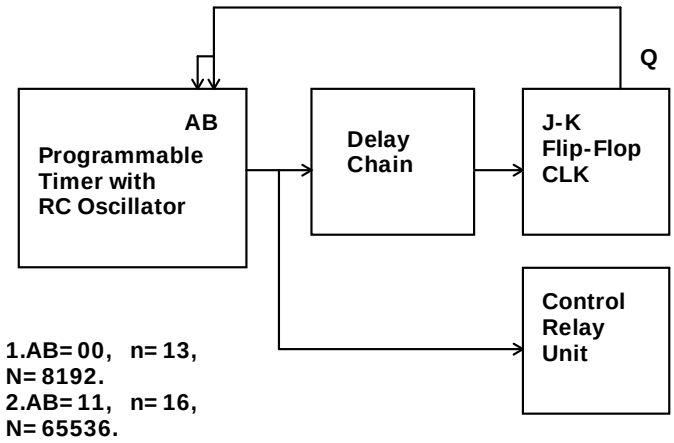

Fig. 3

The action of the scheme is the following: rectangular impulses with frequency of 1 Hz are obtained from the tact generator (RC Ocsillator), which are put on two bi-input logical circuits AND (AND Gate). When starting the system the two counters (Counter 1 and Counter 2) are reset and the output level of the eight-input multiplexer Mx. 1 is zero. Due to this, the tact pulses enter the input of Counter 1 only. The system start finds Counter 3 and Counter 4 in an arbitrary condition. These two counters control multiplexers Mx. 1 and Mx. 2. When Counter 1 reaches the value defined by the content of Counter 3, the output of Mx. 1 becomes unit; the access of the tact pulses to the input of Counter 1 is forbidden and to Counter 2– enabled. The pulses entry to the input of Counter 2 continues until the value defined by Counter 4 is reached. When this value is reached, the output of Mx. 2 passes from null to unit. Counter 3 and Counter 4 increase their contents by one and a differentiating RC chain resets Counter 1 and Counter 2. In this way the system is again reset, the values reached by Counter 1 and Counter 2 being different than those in the previous cycle.

The operation of the special Control Electric Lamp block is the same as in the block diagram in Fig. 2.

Fig. 3 shows the block scheme of a security system designed with a programmable timer and RC oscillator. The oscillator frequency is regulated by the system setup. The J-K trigger pre-programs the timer with the help of its AB inputs.

Each time the timer output passes from zero to unit, the J-K trigger is reverted, thus changing the value of the inputs A and B.

When switching on the power supply, it is not known in what condition J-K trigger is found so we assume that it is in state unit, i.e., Q = 1, hence AB = 11. After 65 536 tact pulses the output of the timer will pass from zero to unit, the J-K trigger will turn to zero (Q=0 and AB = 00) which is a precondition that the timer output stays unit for the time of 8192 tact pulses. The transition from unit to zero at the timer output does not trigger J-K; hence 8192 pulses will be necessary for the timer to change its output level from zero to unit. After J-K is triggered, the timer will need 65 536 pulses for its output to pass into null.

The timer output is connected with relays control and in effect different intervals of switching on and off will be obtained for each operation cycle of the system.

The operation of the special block Control Electric Lamp Unit is the same as in the block schemes in Fig. 1 and Fig. 2.

Brief description of the principal electric circuits of the three security systems

Fig. 4 shows the principal electric circuit of a security system with fixed time intervals of switching on and off. It is completely built on CMOS integral circuits of 4000 series. The consumption is minimal, the supply voltage being from 3 up to 18 Volts.

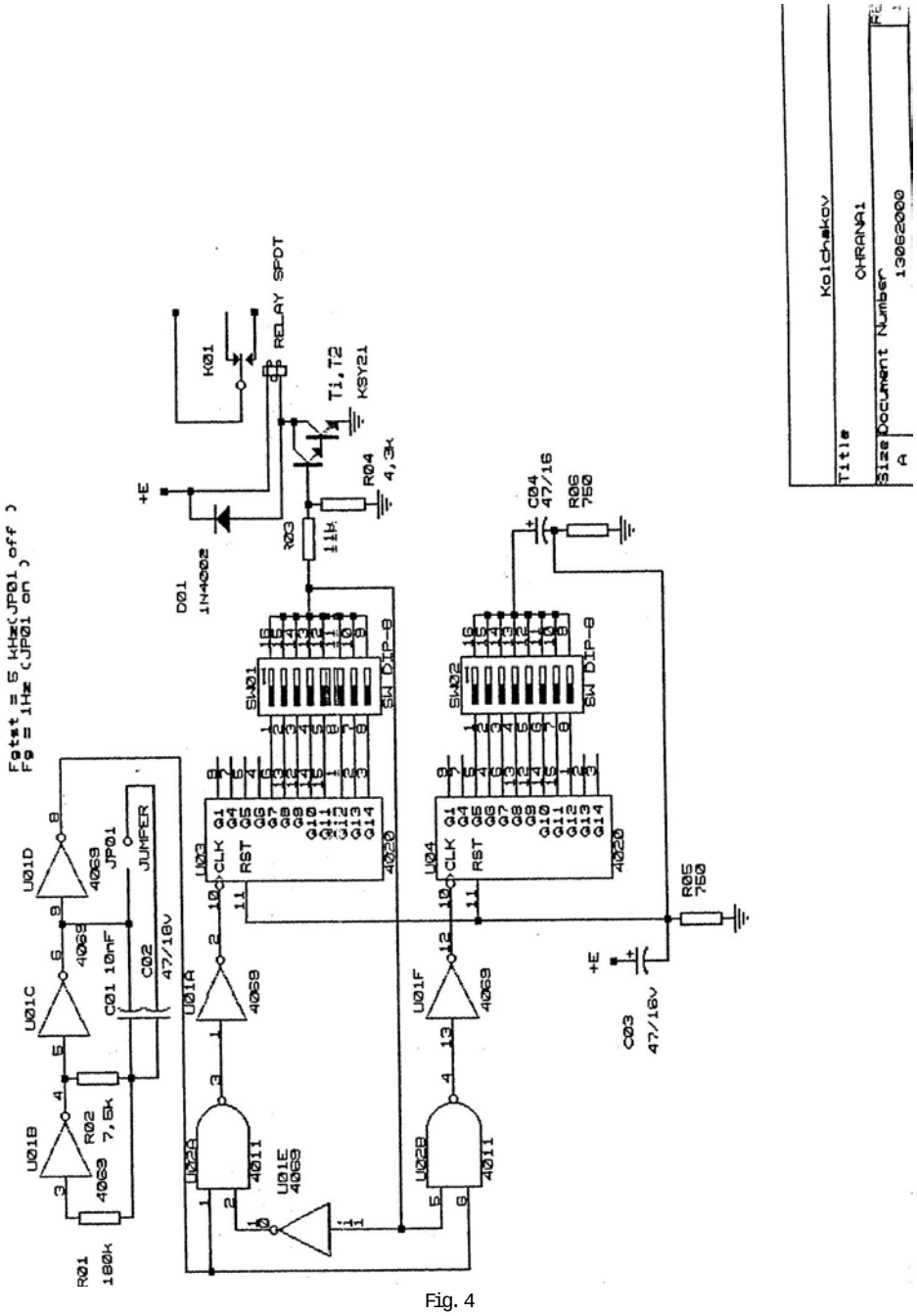

Fig. 4

The impulse RC generator is based on 4069 integral circuit, Counter 1 and Counter 2 – on 4020. Switch 1 and Switch 2 are designed for integral circuits with eight switches each. It is important to note that only one of the eight switches can be on. When switching on the power supply a short positive pulse produced by C03 and R05 resets the two counters.

Fig. 5 shows the principal electric circuit of a security system with automatic pseudo-random alteration of the switching on and off intervals. CMOS integral cir-

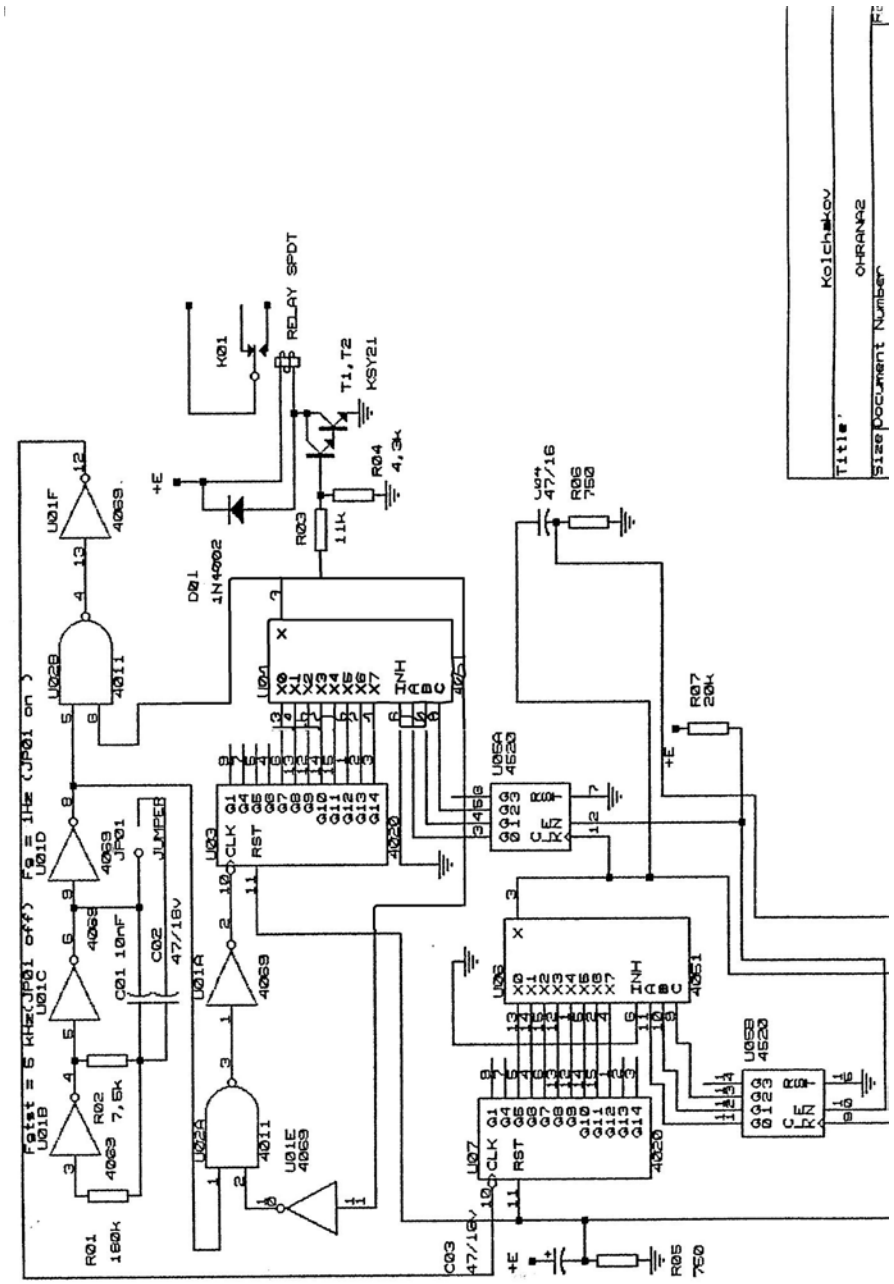

Fig. 5

cuits are completely used. The pulse RC generator is constructed with integral circuit 4069, Counter 1 and Counter 2 – with 4020, and Counter 3 and Counter 4 – with 4520. The multiplexers Mx. 1 and Mx. 2 are designed with 4051 integral circuit. When power supply is switched on, a short positive pulse, produced by C03 and R05, resets Counter 1 and Counter 2.

The principal electric circuit of a security system with a programmable timer is represented in Fig. 6. An integral timer with built in generator 4541 is applied. The generator frequency is set by C01 and R02. J-K trigger is 4027, and the delay for the front of the timer output signal is set by 4069.

The special block Control Electric Lamp Unit is not indicated in the principal circuits for the purposes of simplifying because it is analogous to the Control Relay Unit.

The Control Relay Unit block is built on two NPN transistors, connected according to Darlington circuit, operating in a switching mode and a relay.

The special block Control Electric Lamp Unit is the same with the only difference that before entering the transistor basis the control signal passes through the contacts of a reed relay, controlled by a lighting sensor.

Comparison of the security systems discussed

The comparison is done with respect to the number of the necessary elements for realization (the price), the possibility to set different switching on and off intervals and the possibility for pseudo-random synthesis of the intervals.

The security system with a programmable timer is with the lowest price, followed by the system with fixed switching on and off time intervals. The security system with automatic pseudo-random alteration of the switching on and off intervals is the most expensive.

The security systems with fixed time intervals and automatic pseudo-random alteration of the intervals are identical with respect to the capacity for defining different switching on and off intervals – eight for switching on and eight for switching off, while the system with a programmable timer is with two switching on and two switching off intervals.

The security system with automatic pseudo-random alteration of the switching on and off intervals is the best one concerning its possibility for pseudo-random alteration of the switching on and off intervals. After it the system with a programmable timer follows, while in the security system with fixed switching on and off time intervals this possibility is not available.

Conclusion

The comparison of the security systems imitating human presence shows that the relation price/possibilities is best for the system with a programmable timer. The wide capacities of the security system with automatic pseudo-random alteration of the switching on and off intervals in the operation are recommended for large places guarded.

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Проектирование одного класса охранительных систем, имитирующих присуствие человека

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(Р е з ю м е)

Предлагается подход проектирования одного класса охранительных систем имитирующих присуствие человека в охраняемом объекте. Представлены три вида охранительных систем: с фиксированными времевыми интервалами включения и выключения, с автоматическим псевдослучайным изменением интервалов включения и выключения, с программируемым таймером. Сделан сравнительный анализ проектированных систем по отношении несколько критериев.