Electronic combination lock design using remote control

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Abstract:

In this paper, the cheap circuit of key electromechanical are designed and implemented to provide protection to the buildings, so that, the code is given for authorized people to enter these places and are controlled from the inside and out remotely using a remote control that contains the special code with a very large probabilities up to (20,000,000) possibility. This design consists of two main parts, electronic and mechanic parts, is designed and implemented using the (Orcade program Version 16) with good results.

The Designed electronic circuit (motor circuit) is operates at a specific time, the motor dominated by jagged spiral driven by two-way. The first circuit is controlled on the motor circuit clockwise while the second circuit is controlled on the motor for anti clockwise direction with the duration of time is determined by the designer. Program in (C++ language) is written to calculate the values of τ, w.

Keyword: RF wireless communication, remote control system, transmitter, receiver.

1. Introduction

In the developing world, safety and security is given prime importance. In the day to day life there come various situations in which security is being challenged. The need for developing an error free and cheap security access control system is greatly demanding. It will be a boon in many sectors like banking, defense, and finance. There are situations in which access must only be granted to certain authorized persons. Absence of reliable security systems can lead to catastrophe. The following points show the first attempt to design the electronic circuits for automatic switch. Andy collision was designed and manufacture electronic circuit can be used as a heart of smart switch, used the integrated circuit CMOS4017 and CMOS4001 the features of this circuit have lowest number of resistance and highest number of integrated circuit and this integrated have high reliability and this circuit have 90000 probabilities [1]. Ejaz Ur rehman designed simple electronic lock use single-transistor circuit, very simple and cheap but have low probabilities [2]. A-JEYABAL designed and implemented simple electronic lock circuit but not efficient and have low probabilities [3]. Mr.RON.J was designed and manufacture electronic circuit can be used as a heart of smart switch with 12 switches which has 10000 probabilities he used the integrated circuit CMOS4081with group of capacitors and resisters [4]. In This paper a wireless remotely controlled home system is designed and implemented.

2. Physical design and Construction / Component Selection

Door lock Motor controller

The motor for the door opener operates with +/-5V and 250mA**.** Amplitude Modulation is suitable when it is not necessary to be able to reverse motor direction, when there is a need for controlling the speed of a DC motor in an efficient manner, driver circuitry can be rather simple, as shown in Fig.(1). The motor drive circuit ground must of course, be tied to the ground for the circuit to work. The 1k gate resistor is used to add some degree of isolation of the motor drive possible damaging back EMF transient spikes from the 68HC1x output pin [6]. The Zener diode (optional) adds extra protection. But if you really want to do it right, put an optoisolator between the 68HC1x output and the motor drive circuit [7]. The simplest method of implementing is controlled H-bridge drive of a reversible DC motor is to buy one of many commercial H-bridge IC's available on the market. These can be purchased separately as an H-Bridge with a separate H-Bridge controller IC, or as an all-in-one IC. Unfortunately, there are several hurdles that sometimes frustrate this approach.

One option is to build your own H-bridge from discrete parts, as shown in Fig. (2).

The following system illustrates a typical H-bridge design which utilizes discrete components. This approach allows the user to select N-channel MOSFET devices suitable for driving high current motors [8]. The MAX620 device is available from MAXIM and is known as a "Quad, High-Side MOSFET Driver", designed specifically for this application. Due to my inability to create good quality schematics, I have omitted some of the detail on the MAX620 chip (pin numbers etc.) [9]. The MAX620 and H-bridge circuitry must share a common ground for the circuit to work [10]. The NOR gate logic and MAX620 (V_{cc}) should be driven by a separate +5V supply [11]. Although many MOSFETs contain an internal "freewheeling" diode to shunt back-EMF currents from the motor, we show external diodes across each MOSFET. Use of external diodes is advised (even if the MOSFETs have internal diodes) as the internal MOSFET diodes (if any) may not be heavy duty and could undergo failure[12].

Although not shown, the user might also consider using optoisolation of the forward/reverse signals that come from the MAX620. Also note that the

MAX620 may modulate the forward and reverse signals as a means to control motor speed. The logic for the forward/reverse tables is shown in table (1) [13,14,15,16]

Table (1) the logic for the forward/reverse for the MAX620.

Forward	Reverse	Case of motor
0	0	Stopped (idle)
1	0	Goes forward
0	1	Goes in reverse
1	1	Bozo nono

In the case of Bozo NoNo -- will blow up circuit unless NOR logic used.

The NOR logic shown will protect against this condition. In this case the motor would go forward when Forward=1 and Reverse=1. Finally, this circuit does not protect against excessive motor current (as in the case of a **stalled motor**, some integrated H-Bridges offer this feature. Perhaps this could also be addressed, e.g. by placing a suitable "fast-blow" fuse in series with the motor supply battery. Also, when reversing direction (going from forward to reverse or vice-versa), it's advisable to implement a short delay in your code that turns all the MOSFETs off briefly. E.g. (1) you go forward. (2) You turn both the forward and reverse signals off briefly (say 0.5 sec). (3) You then assert the reverse signal. In this way, you make sure that the one pair of MOSFETs has had more than enough time to completely turn off, and you help avoid problems with stripping gears (by suddenly reversing the motor direction [17]. To control on motor, the original concept of the H-Bridge was being able to control the direction a motor was going, Forward or backward. This was achieved by managing current flow through circuit elements called transistors or relay. The formation looks like an H and that's where it gets the name H-Bridge shown in Fig. (3). When illustrates the 4 base cases that we can get out of the simple version of an H-Bridge. The two cases that interest us are when A & D are both 1 and when B & C are both 1. When A & D are 1 current from the battery will flow from point A through the motor to D's ground. However for the case when B & C are both 1, current will flow in the opposite direction from B through the motor to C's ground [18].

Antennas:

¼ Wave Whip Stub Antenna made by R.F. Solutions and is tuned to the frequency of 433.92MHz [19].

Remote Control main Procedure

The PIC takes input from buttons pressed by the user on PORTC, then processes which button was pressed and produces an output on PORTD which is sent to the encoder. The encoder creates an encrypted signal which is sent to the transmitter. The transmitter then transmits the signal through the antenna. After the signal is transmitted, the PIC waits for a signal to be received from the device attempting to be controlled. When the signal comes in from the antenna, it is passed to the decoder, decrypted, and then passed to an input on PORTC on the PIC. This input is processed by the PIC and the output is sent from PORTD and then the appropriate LED is turned on to notify the user of which device has responded.

Wireless Communication (RF)

Radio Frequency, The portion of the frequency spectrum in which electromagnetic waves can be generated by alternating current which is than fed to an antenna. The use of some form of radio wave technology to transmit signals [20].

Battery Backup

The electromagnetic deadbolts for our door lock are unable to be opened during a power outage since they run off of line voltage. If there was a mechanical systems in place to allow the user to physically push the deadbolt open from the outside, this could be a security risk as anyone could unlock the door.

Instead of an insecure physical movement solution, a battery backup system would be better. If there was a manual key lock to the deadbolt that triggered a battery backup to apply power to the deadbolt, it would allow the user to unlock their door during an outage. This is not currently implemented in our system's design.

Statistical Calculations [20]

The probabilities of the designed system can be calculated according to the following equation:

$W = n! / (n - K)!$ ……………………………………(2)

Where : W = number of probabilities.

n = number of inputs of the external switch.

K = number of desired input that must be fed to the electronic circuit.

In the designed system three integrate circuit (LS 7220) has been used, each with four inputs, so the total numbers of the inputs to the system will be twelve.

So that: n = K in equation one, substitute this case in equation one we get

$$W = n! \qquad \text{……………………………………………………………………….(3)}$$

The practical side of the circuit design

2.1. Transmitter

This paper uses the R.F. Solutions AM Hybrid transmitter module (AM-TWS-434). This module provides a complete RF transmitter which can be used to transmit data at up to 4 kHz from any standard CMOS/TTL source. It is designed to operate with a supply voltage of 1.5-12V at an RF frequency of 433.92MHz. They have an ideal transmit range up to 70 meters. The modules are compatible with R.F. Solutions range of AM receivers. These transmitters are also designed to work with the (CIP-8E) encoder, produced by R.F. Solutions. RF output power is 8 mW.

2.2. Receiver

This paper uses the R.F. Solutions AM Hybrid receiver module (AM-RWS-434). This module provides a complete RF receiver which can be used to receive data at up to 4kHz from any standard CMOS/TTL source. It is designed to operate with a supply voltage of 4.5-5.5V at an RF frequency of 300-434MHz. They have an ideal receive range up to 70 meters. The modules are compatible with R.F. Solutions range of AM receivers. These receivers are also designed to work with the (CIP-8D) decoder, produced by R.F. Solutions. There is one RF Transmitter is use in this system. The R.F. Solutions range of AM receiver module is compact hybrid RF receiver which can be used to capture undecoded data from any AM transmitter. They produce a CMOS/TTL output, and require connections to power and antenna only. The AM-RWS-434 is a miniature AM receiver. The AM-RWS-434 is an AM super-regenerative receiver. Both of these devices were produced by R.F. Solutions. They use a supply voltage of 4.5-5.5V and operate at an RF frequency of 433.92MHz. They have an optimal receiving range up to 50m. They are manufactured to be compatible with the AM Transmitters (AM-RWS-433) produced by R.F. Solutions. These receivers are also designed to work with the (CIP-8D) decoder, produced by R.F. Solutions.

Operating principle of the circuits is shown in Figs (10),(11),(12), a signal is send from the transmitter type (CIP-8E) and received by the receiver type (CIP-8D) and then transferred to the integrated circuit type TPS 2086, which contains 8 keys to an internal turn to (fixed) and all signal turn out to be a reference in the form of voltage (DC) to the integrated circuit type (LS7220), The four signals that received must be in sequential arrange and consistent specifications and circuit (D-flip-flop) and graduated the first output signal reference to the circuit of the type LS7220) integrated. The second signal handling logical Department (Land) and out of the circuit (Land) working to make a circuit Mosvet (fixed) and Mosvet in turn makes the (relay) fixed control of the Department mug for the Timer, which works to generate a signal to the circuit of control the motor who shall run it by the time of timer and the motor works Mechanical control.

Transmitter, so-called encoder (simple remote control), which is a IC only does the work of the oscillator output oscillator and voltage needs of the (+3-5.5 V) VCC to work and take her from the bar (4 Battery) and gives us (8 of digital signals (D0-D7) of the IC (9-10-11-12-13-14-15-16), that the entry of the voltage VCC by pin1, while p20 is the ground ground. Go signals emerging from the present into the redeiver, Decoder IC, a type of CIP-8D.

The receiver, (consists of antenna) which receives of signals is of the type RWS-434 need to be 1 – *Power supply* = 12V for the processing of the entire electronic Transistor and 2- *Relays*. Decoder is the kind of CIP-8D, where received signal from the antenna type RWS-434 and sent TR the a (8 references) and be relatively weak, where the receiver to send a signal to the transmitter when pressed manually by TR is called (signal enabling the integrated circuit TPS2086 so runs the IC and the (2 integrated circuit) of each circle IC with 4 switches work. These switches by giving a signal 5 V to the integrated circuit LSI7220. every four signals goes towards TPS2086 to LSI7220 and that the IC circuit gives us the signal and one Volt (DC) certain and this signal is on the transistor, who works as a key power switch and circuit control of the relay (5 V) and consists of switch one (one gate) and the relay controls the timer and timer controls the second relay which in turn controls the motor switch consists of the 2 gates and called the circle opening. Circuits that control the And Gate timer, and controls the relay and thus controls the motor, which controls on the door.

Carry-over: There relays in the circuit, the first relay controls the timer which in turn controls the second relay which has four gates.

The first Reference point will be stored in Flip-Flop 1 first IC1, The second point: you will be stored in Flip-Flop 2 second IC2, and the third point, you will enter into And Gate IC3.

Designing principle of the switch depends on many assumptions such as:
The heart of the switch is the two integrate circuit (LS 7220), MOS digital lock circuit and two integrate circuit (TPS 2086) and the two integrate circuit CIP-8E as transmitter, CIP-8D as receiver).

Electronic Timer design

The timer design is consist of 555 IC's for the following reasons; *first* is High temperature stability, *second* is Adjustable duty cycle, and the *third* is Monostable operation.

There are two important notes one can take into consideration:

1. The triggering of the circuit in order to produce the output pulse.
2. Determination of the pulse duration.

The first problem can be solved by using Semiconductor switches, these switches are three types; *first*: Thyrestor (is shown in Fig.(6), *second*: Optocoupler (is shown in Fig.(6), and the *third* is MOSFET transistor (is shown in Fig.(7).

While the second problem can be solved by using the following equations:

$\tau = 1.1 \times R_3 \times C_5$ ………………………………………………..(1)

The units of the resistors are in Ohm, the capacitors in Microfarads and time in seconds.

By using the monostable, or one-shot, circuit produces a single pulse when triggered. As you can see, the trigger input is held HIGH by the 10KΩ pull-up resistor and is pulsed LOW when the circuit is triggered. The circuit is triggered by using one of these three techniques Fig.(4),(5),(6). The period (t) output can be calculated from the design equations:

$\tau = 1.1\ RC$

where: R = resistance in Ohm, C = capacitance in Farad, τ = time in Sec.

Results and discussion

In this research, Fig.(6) shown the MOSFET transistor is connected to the circuit in this research. Table 1 shows many tests have been done on the circuits in Fig.(4),(5),(6) by changing the resistors R_3 and C5 and the results shown in the following table:

Type of the switch	**Resistor R_3 (KΩ)**	**Capacitor C_5 (µf)**	**Time τ (Sec) Theoretically**	**Time τ (Sec) By using simulink**
Thyrestor	59	220	14.278	14
	88	440	21.296	21.5
	59	440	28.556	28.4
Optocoupler	59	220	14.278	14
	88	440	21.296	21.5
	59	440	28.556	28.4
MOSFET transistor	59	220	14.278	14
	88	440	21.296	21.5
	59	440	28.556	28.4

Table 1 shows theoretical and simulink results for the three types of switches.

Figs (7), (8),(9) shows the time response for each type of the switches. There are no timing issues in our design we can control the time execution of the system. The serial connection responds function without any noticeable latency. The speed of the system depends on the timer controlling the motor. The size of the motor is proportional with size of the door. The motor is fixed to the wall or wooden supports so there is no error du to motor torque. About the safety of the system the major concern we worried about the number of code probability which is equal 2^{12} is very high, and the system has no any healthy affected.

Programming Language and Programmer Used

The C++ programming language was chosen for solve the equation of τ and w respectively.

Conclusion

When you are coming home with a load of groceries, and do not have a third arm to open the door, wouldn’t it be nice to have the Wireless Remotely Controlled System? Pushing a button to unlock your front door, open the door, and turn the lights on for you sound appealing? The Wireless Remotely Controlled System is a complete bi-directional, encrypted communication solution to combat the slow march of evolution giving you the third arm required to carry whatever your current two arms can handle. This system of convenience is built for people, who are elderly, have disabilities, muscle or back problems, or who are just tired of fighting with their front door, and searching around in the dark.

From the results obtained of this research we conclude that ,The system is safe, accurate and has high efficiency, The system can be used for commercial, and The system can be devolved and use coding technology by using the finger and eyes.

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Programmgramming Language and Programmer used

Program (1): calculate the value of τ

```
#include<iostream.h>
void main()
{
float t,r,c;
cout<<"please enter the value of resistor(R3) : ";
cin>>r;
r=r*1000;
cout<<r<<" ohm ";
cout<<"\n"<<"please enter the value of capacitor (C5): ";
cin>>c;
c=c*0.000001;
cout<<c<<" farad ";
t=1.1*r*c;
cout<<"\n"<<"the value of time ( Theoretically )  T is : "<<t<<"  sec";
}
```

Program (2): calculate the value of w

```
#include<iostream.h>
void main()
{
float w,n,k,temp1=1,x,r,temp2=1;
l2:
cout<<" please enter the  number of inputs of the
external switch ( n )  ";
cin>>n;
l1:
cout<<"\n please enter the number of desired input
that must be fed to the electronic circuit ( K ) ";
cin>>k;
if(n>k)
{
for(int i=n;i>1;i--)
temp1=temp1*i;
x=n-k;
for(i=x;i>1;i--)
temp2=temp2*i;
w=temp1/temp2;
cout<<"\n \n the number of probabilities ( W ) is :
"<<w;
}
else
{
cout<<"the value of K must be less than the value of
n please correct the value of k ";
cout<<"\n";
goto l1;
}
cout<<"\n \n \n";
goto l2;
}
```

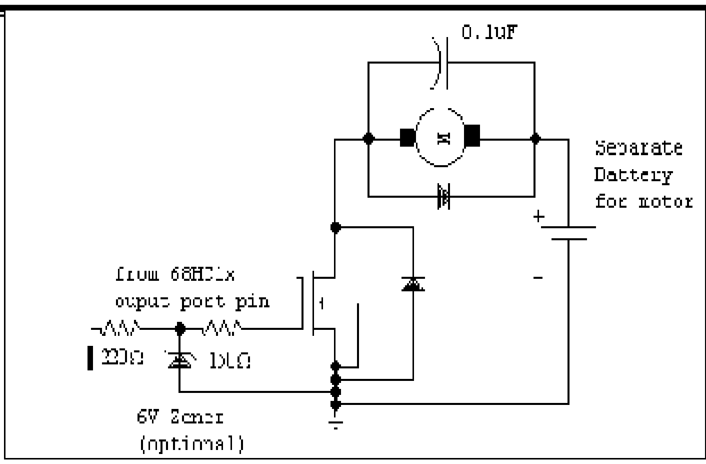


Fig.(1) Typical unipolar DC motor drive circuit

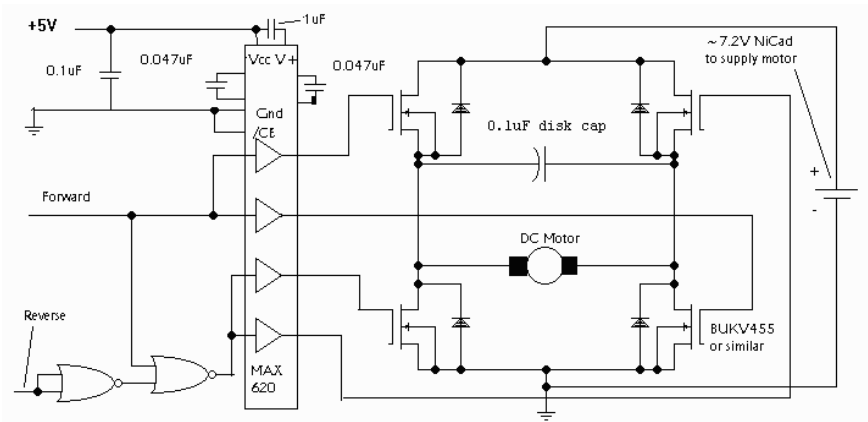
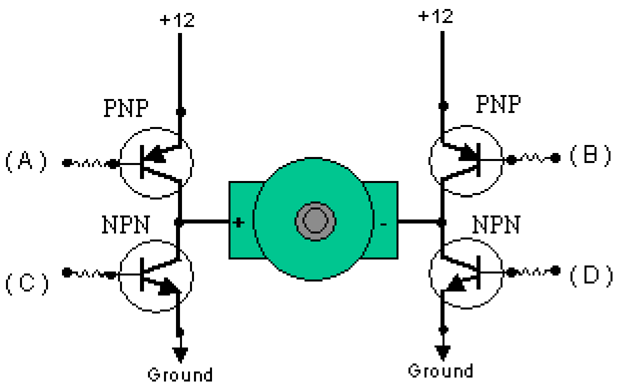


Fig.(2) Typical Discrete Component H-bridge circuit.



A	B	C	D	Function
1	0	0	1	Forward
0	1	1	0	Reverse
1	1	0	0	Brake
0	0	1	1	Brake

Fig. (3) H-Bridge Diagram

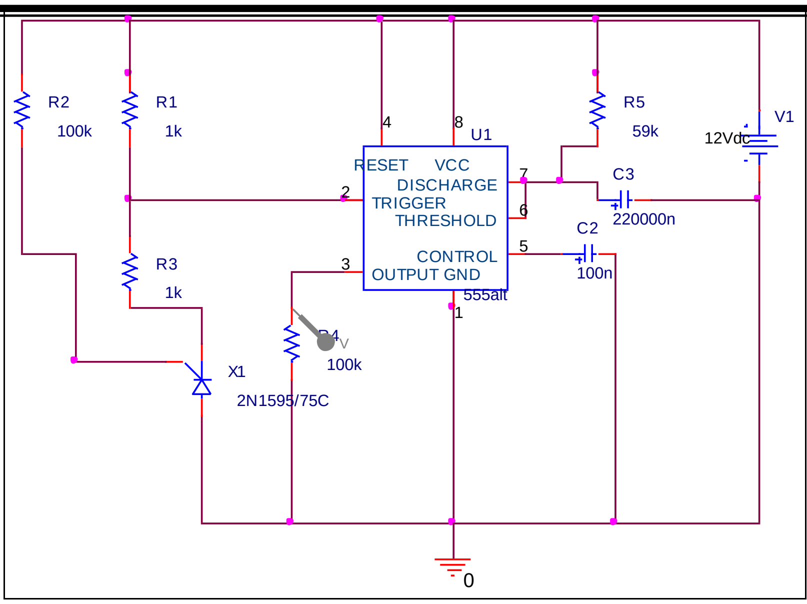


Fig.4 shows the circuit when Thirstier is connected.

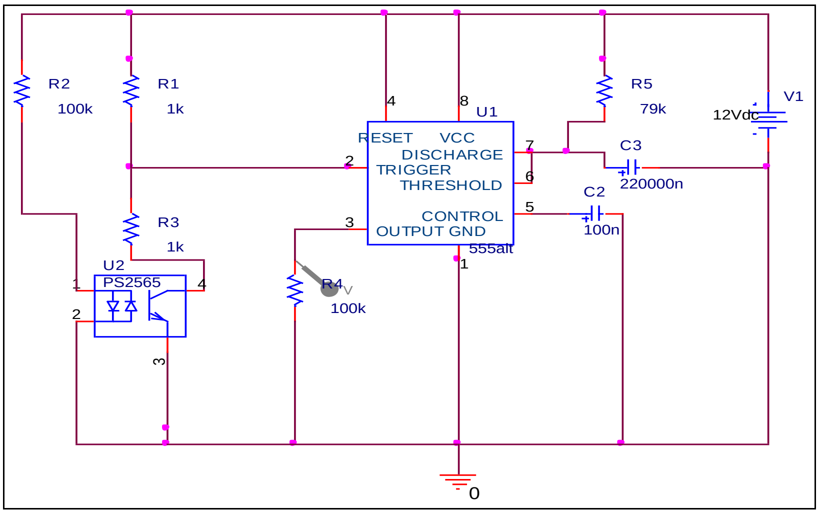


Fig. 5 shows the circuit when Optocoupler is connected.

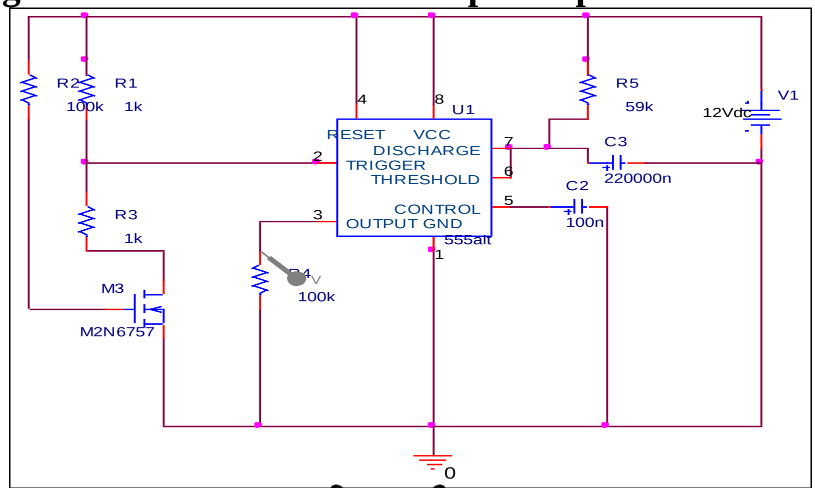


Fig. 6 shows the circuit when MOSFET transistor is connected.

Fig. 7 Time response for all three type switches

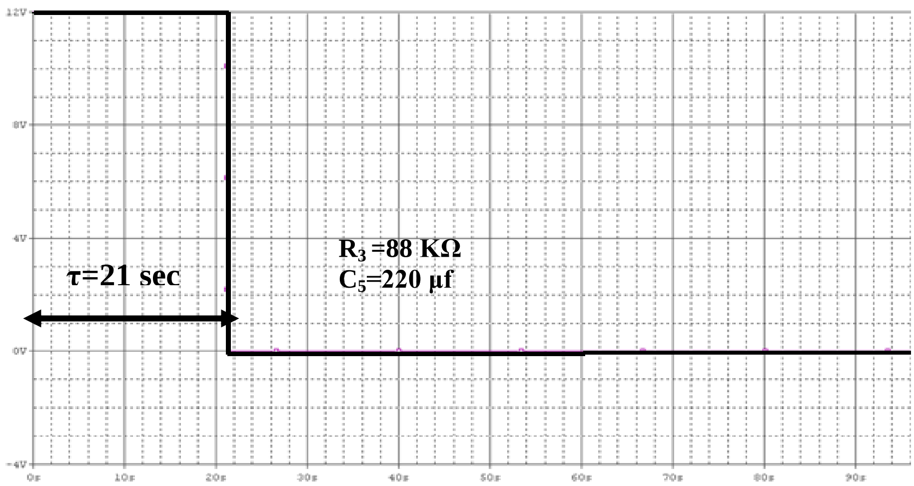


Fig. 8 Time response for all three type switches

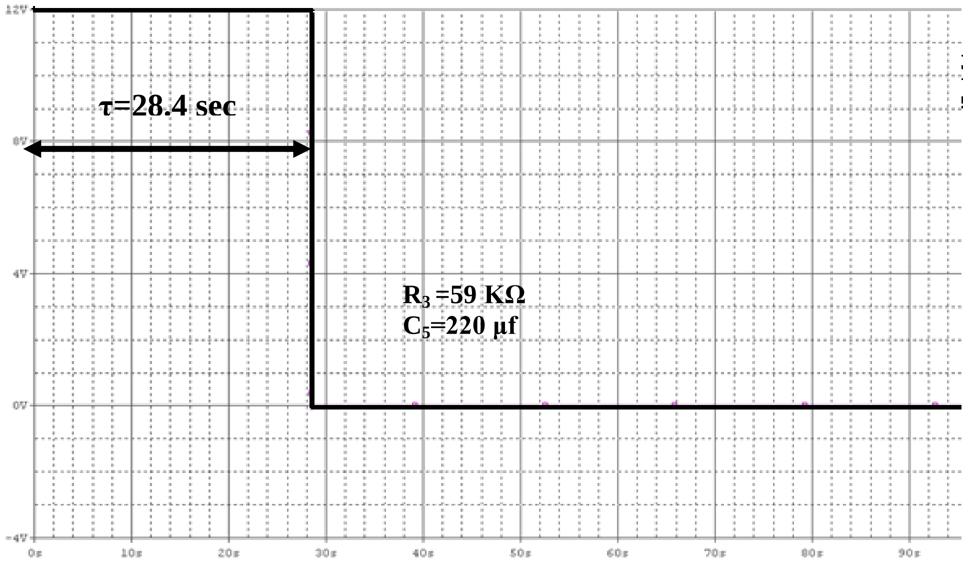


Fig. 9 Time response for all three type switches

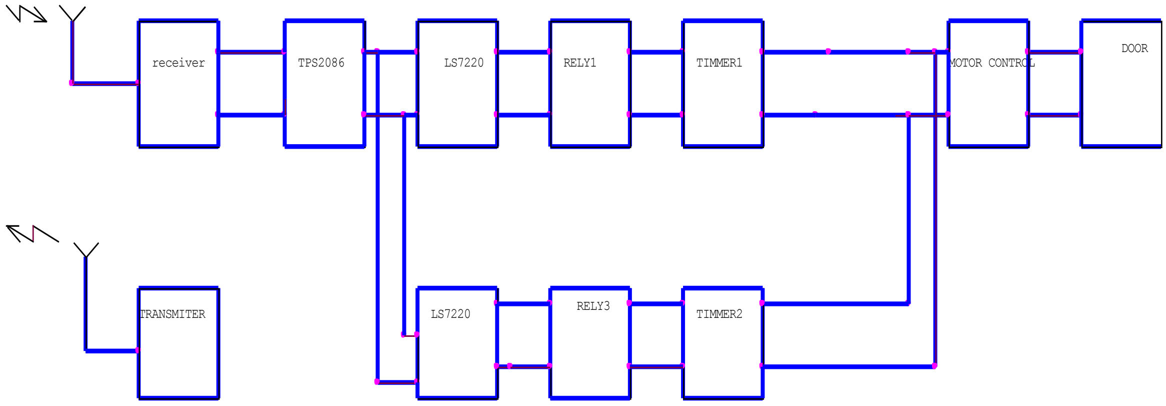


Fig (10) Block diagram of the automatic switch

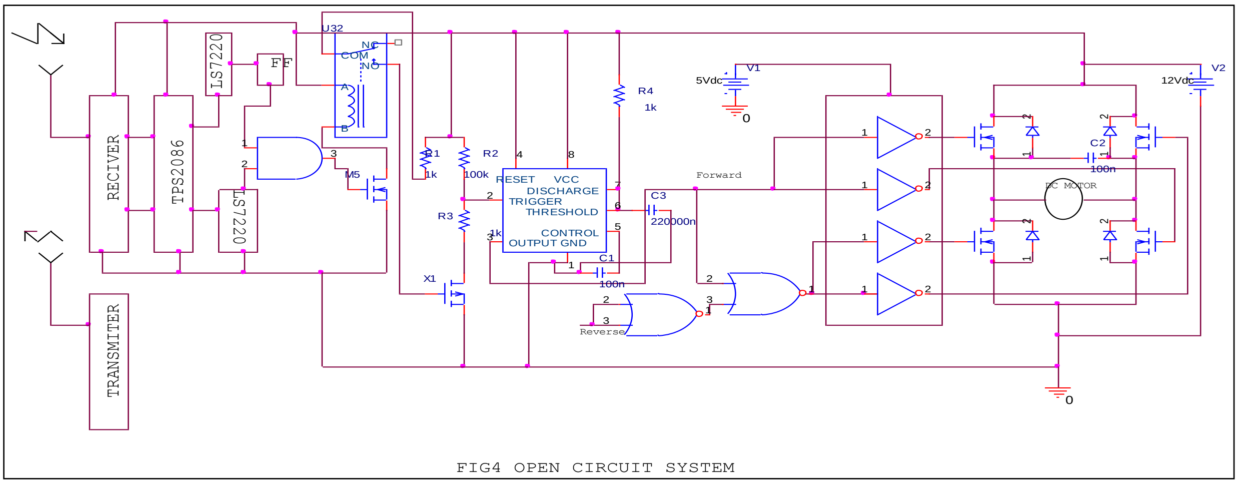


Fig. (11) Open circuit system

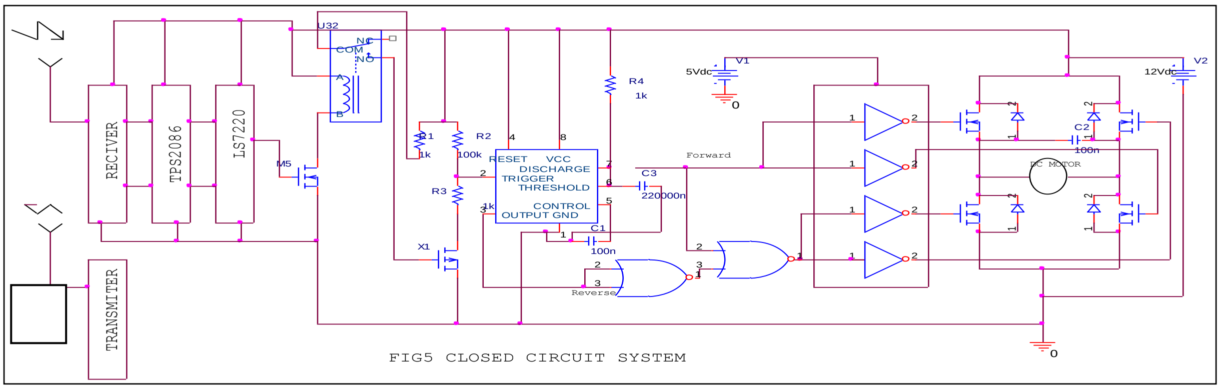


Fig. (12) Closed circuit system

تصميم قفل الأرقام الإلكتروني بإستعمال جهاز التحكّم عن بعدِ

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حيدر شريف مهدي
مركز بحوث الطاقة والوقود

الخلاصه:-

في هذا البحث تم تصميم وتنفيذ دائرة مفتاح الكتروميكانيكي رخيص الثمن لتوفير الحماية للبنايات بحيث تُعطى الشفرة للاشخاص المخولين بدخول هذه الاماكن ويتم السيطرة علية من الداخل والخارج عن بعد باستخدام جهاز الريموت كونترول والذي يحتوي على شفرة (كود) خاص وباحتمالات كبيرة جداً تصل الى حدود (20,000,000) احتمال، يتكون التصميم من جزأين رئيسيين، جزء الكتروني والاخر ميكانيكي، هذه الدوائر الالكترونية نفذت بأستخدام برنامج (Orcade Version 16) وتم الحصول على نتائج جيدة.

الدائرة الالكترونية المصممة (دائرة ماطور) تشتغل بوقت محدد ، الماطور يُسيطر عليه عن طريق مسنن حلزوني يدفعه باتجاهين. الدائرة الاولى تُسيطر على الماطور باتجاه عقرب الساعة ، والدائرة الثانية تُسيطر على الماطور باتجاه عكس عقرب الساعة وبمدة زمنية يتم تحديدها من قبل المصمم. تم تكتابة برنامج بلغة (C++) لحساب قيم τ و w.