Magnetic Door Alarm Circuit Using Hall Sensor

Introduction:-

Door alarm is a very common and useful device for security purpose. They are used to detect whether the Door is open or closed. Often we have seen some door alarm in the refrigerator that produced a different sound when they activate.

This time we have decided to make a Door Alarm by using Hall Effect Sensor and 555 timer IC.

Components Required:-

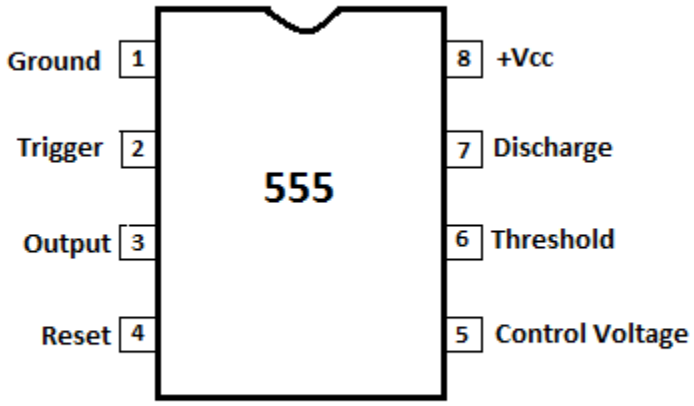
1. ***555 Timer IC***
2. ***Buzzer***
3. ***Bread Board***
4. ***Resistor 1K - 4***
5. ***Resistor 10K***
6. ***50k POT***
7. ***LED***
8. ***10uF Capacitor***
9. ***Jumper wire***
10. ***9V battery or supply***
11. ***LM7805 Voltage Regulator***
12. ***Transistor BC547***
13. ***3144 Hall Effect Magnet Sensor***

THEORY (About the Project):

IC 555 (555 Timer):

The 555 timer IC is an integrated circuit (chip) used in a variety of timer, pulse generation, and oscillator applications. The 555 can be used to provide time delays, as an oscillator, and as a flip-flop element. Using 555 timer IC, we can generate precise time duration of HIGH and LOW output, from micro seconds to hours.

PIN DIAGRAM :



Operation of 555 timer in Astable mode:

→When initially power is turned ON, Trigger Pin voltage is below Vcc/3, that makes the lower comparator output HIGH and SETS the flip flop and output of the 555 chip is HIGH.

→ This makes the transistor Q1 OFF, because Q'=0 is directly applied to base of transistor. As the transistor is OFF, capacitor C1 starts charging and when it gets charged to a voltage above than Vcc/3, then Lower comparator output becomes LOW (Upper comparator is also at LOW) and Flip flop output remains the same as previous (555 output remains HIGH).

→ Now when capacitor charging gets to voltage above than 2/3Vcc, then the voltage of non-inverting end (Threshold PIN 6) becomes higher than the inverting end of the comparator. This makes Upper comparator output HIGH and RESETs the Flip flop, output of 555 chip becomes LOW.

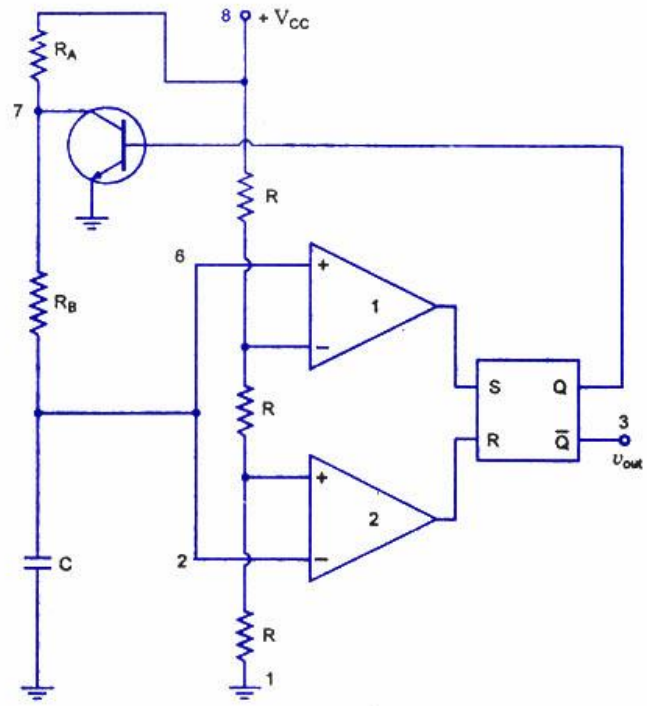
→ As soon as the output of 555 get L OW means Q'=1, then transistor Q1 becomes ON and short the capacitor C1 to the Ground. So the capacitor C1 starts discharging to the ground through the Discharge PIN 7 and resistor RB.

→ As capacitor voltage get down below the 2/3 Vcc, upper comparator output becomes LOW, now SR Flip flop remains in the previous state as both the comparators are LOW.

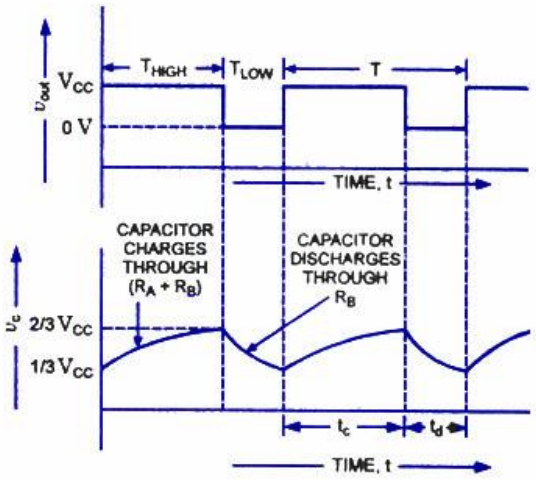
→ While discharging, when capacitor voltage gets down below Vcc/3, this makes the Lower comparator output HIGH (upper comparator remain LOW) and Sets the flip flop again and 555's output becomes HIGH.

→ Transistor Q1 becomes OFF and again capacitor C1 starts charging.

→The time, TH, for which the output is "ON" is: TH = 0.693 (RA+RB).C



Internal Circuitry With External Connections



Capacitor and Output Voltage Waveforms

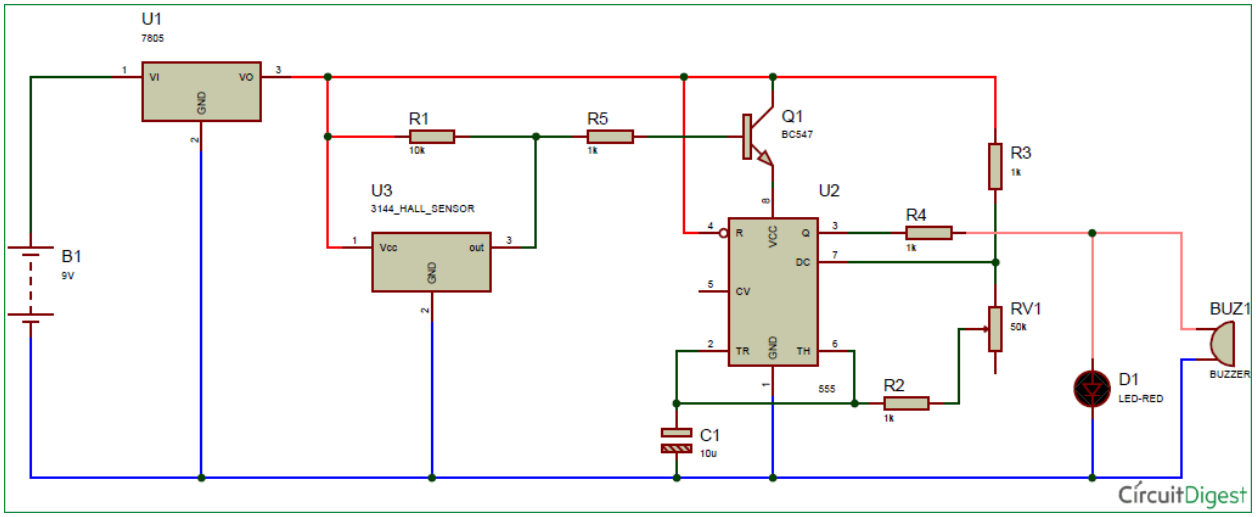
Astable Operation

Hall Effect Sensor:

A Hall sensor is a device which can detect the presence of a magnet based on its polarity. It is a transducer which generates a signal according to magnetic field present near it. Here we have used 3144 Hall Effect Sensor which has a range of about 2cm.

As the name suggests the Hall Effect sensor works with the principle of "Hall effect". According to this law "when a conductor or semiconductor with current flowing in one direction was introduced perpendicular to a magnetic field a voltage could be measured at right angles to the current path". Using this technique, the hall sensor will be able to detect the presence of magnet around it.

Circuit Diagram and Explanation:



In this Magnetic Door Alarm circuit, we have used a 555 timer IC in astable mode to generate a tone as an alarm; frequency of tone can be adjustable by using an attached RV1 potentiometer. Here we have connected a 1k (R1) resistor between Vcc and pin 7th of 555 Timer (U2) and a 1k (R4) resistor & 50k Pot (RV1) between pin 7 and 6. Pin 2 shorted with pin 6 and a 10uf C1 capacitor is connected to pin 2 with respect to ground. Pin 1 is connected to ground and pin 4 directly connected to VCC and pin 8 as well by using a transistor. A Hall Effect Sensor or magnet sensor is used to detect if the door is open and close. It's output connected to the base of the transistor BC547 which is responsible to provide a path to 555 timer IC. A buzzer and an LED are connected on Pin 3 of 555 for indication of alarm. Finally, we have connected a 9v Battery to power the circuit

Working Explanation:-

Working on this Magnetic Door Alarm is tricky. Here we have made a 555 astable multi-vibrator for generating alarm signal as we already mentioned. But we are controlling this astable multi-vibrator U2 by using Hall Sensor U3 through an NPN transistor Q1 BC547.

When we put magnate near Hall Sensor then hall sensor senses the magnetic field and generates a Low signal as an output. This output goes to the base of the transistor. Due to Low signal, transistor remains turned off and power is not supplied to 555 timer IC and buzzer remains silent with LED turned off.

Now when we take magnate far from the hall sensor then hall sensor generates a High signal which goes to the base of the transistor. Due to high signal transistor gets turned on and make a path for astable multi-vibrator supply. And when astable multi-vibrator has supply then it starts working and generates an alarm tone and flashing LED as well. The user can change the frequency of tone by moving RV1 potentiometer.

So now we can attach this circuit in Door frame and a magnet in the Door, now when the gate is closed magnet (door) and hall sensor (Door Frame) will remain near and the alarm will remain off. Whenever someone opens the door, the magnet will get away from the Hall sensor and it will make the hall sensor High and trigger the LED and alarm connected to 555 IC.

Conclusion:-

We have successfully implemented the functioning and mechanism of a working magnetic door alarm security system with the usage of the IC 555 timer in its astable configuration to show its use in the practical world applications.