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Development of a Simple Sound Activated Burglar Alarm System

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Abstract

The paper presents the design, construction and testing of a simple sound activated burglar alarm. The principle of operation of this burglar alarm is simple. When the intensity of sound exceeds certain intensity, the alarm is triggered and the siren begins to operate. The speaker beeps and the flasher (light) flashes. These actions thus alert the owner of the residence and/or security personnel of the presence of an intruder.

Keywords

Alarm system, Sound, Design

Introduction

Burglar alarms systems are increasingly being used in private homes, offices, stores and other businesses. They have become standard equipments especially in stores, warehouses etc. The system is also suitable for use in jewelry stores, artifacts in museums and for safe guarding drawings, paintings and sculpture in art galleries and also to detect unauthorized access.

Alarms as the name implies are used to alert in the event of any situation that is a threat. There are several kinds of alarms [10]. Some of them include fire alarms, burglar alarms, indicator alarms, heat and smoke detectors, etc.

The approach used in this work is the modular approach where the overall design was first broken into functional block diagrams, where each block represents a section of the circuit that carries out a specific function. The functional block diagram of Figure 1 also shows the interconnection between these blocks. Each section of the block is analyzed below.

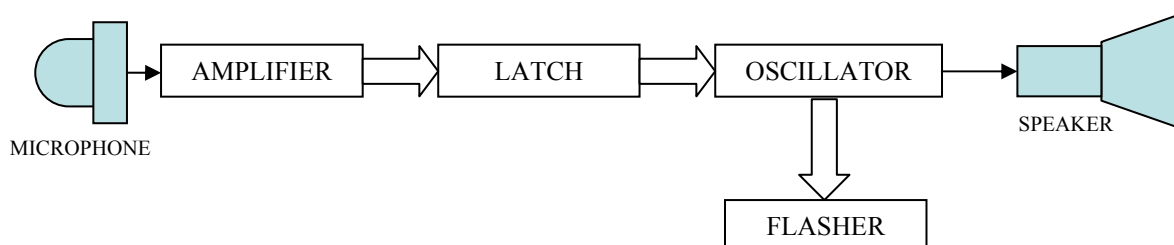


Figure 1. Block diagram of sound activated burglar alarm

Analysis and Design

A 600 Ω unidirectional moving coil microphone was used. The moving coil microphone can be used with considerable lengths of cable without the need for amplifiers close to the microphone mouthpiece [3, 4].

The amplifier stage was built around an LM386 CMOS operational amplifier [2, 6]. The circuit arrangement is such that it can amplify an input signal up to 200 times its original value. Figure 2 shows the circuit diagram to illustrate the circuit.

The basic function of the amplifier stage is to amplify the input signal from the microphone to up to 200 times its original value and pass it on to the latch section of the burglar alarm circuit for further processing. The latch stage basically built around the CD4013B CMOS dual D-type flip-flop [1, 7]. The CD4013B dual D-type flip-flop is a monolithic complementary MOS (CMOS) integrated circuit constructed with N- and P-channel enhancement mode transistors. Each flip-flop has independent data, set, reset, and clock input and “Q” and “Q” outputs. These devices can be used for shift register applications, and by connecting “Q” output to the data input, for counter and toggle applications. The logic level present at the “D” input is transferred to the output during the positive-going transition of the clock pulse. Setting or resetting is independent of the clock and is accomplished by a high level on the set or reset line respectively.

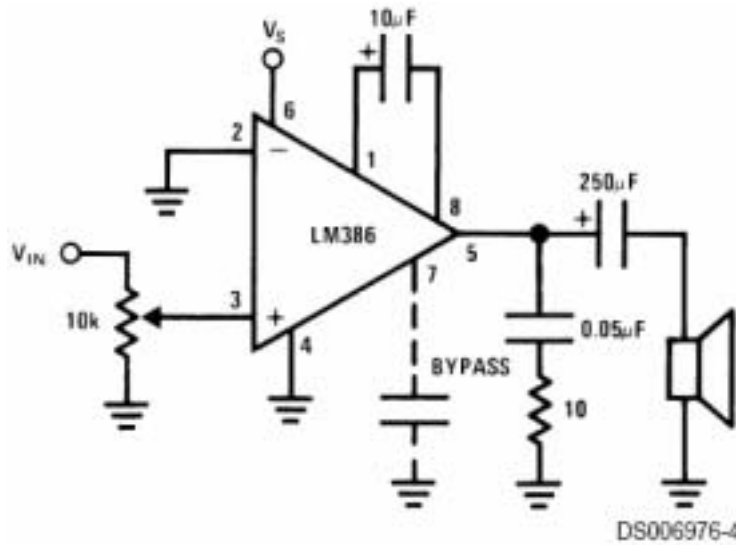


Figure 2. Circuit Design for an LM386 Low signal amplifier with gain = 200

Only one of the flip-flops was used in the design connections. Flip-flops are basically memory circuits. They have the ability to remember previous occurrence [3, 5 and 8]. Once triggered and a LOW signal is applied at both the RESET and SET inputs, the flip-flop maintains the previous state of the output until the set input goes high. The reset button would be connected to pin 6 if flip-flop 1 is used and to pin 8 if flip-flop 2 is to be used.

Once a sound that exceeds certain intensity, it is picked by the microphone, amplified and sent to the latch, the latch keeps the alarm still ringing until the reset button is pressed. The oscillator design was built around the CD4060B CMOS integrated circuit [9]. The CD4060B is a 14 stage ripple carry binary counter. The counters are advanced one count on the negative transition of each clock pulse. The counters are reset to the zero state by a logical “1” at the reset input independent of clock.

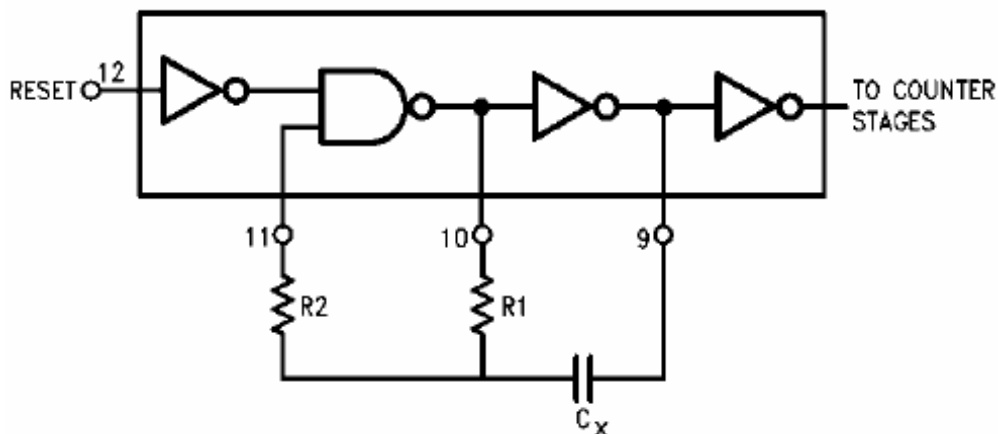


Figure 3. Oscillator connections for the CD4060B integrated circuit

For the oscillator design, typically the following were implemented:

1. $R_2 = 2R_1$ to $10R_1$
2. RC Oscillator applications are not recommended at supply voltages below 7.0V for $R_1 < 50$ k Ω .
3. $f = 1/(2.2R_1C_1)$

The values used in the design were $R_1 = 100$ k Ω , $R_2 = 330$ k Ω

The output stage basically consists of the speaker circuit and its transistor driver and the flasher circuits. The siren circuit was designed using an 8 Ω , 3W speaker driven by a 2SD400 transistor, while the flasher circuit was driven by a 2SC945 transistor via a 4.7k Ω limiter resistor connected to its base. Two different frequency outputs from the CD4060B were connected to the speaker and flasher respectively. Once the alarm is triggered the speaker beeps and the LED flashes until the reset button is pressed. The over all circuit arrangement for the design showing all connections and components used is shown in figure 4. Discussion on power supply to the circuit is omitted.

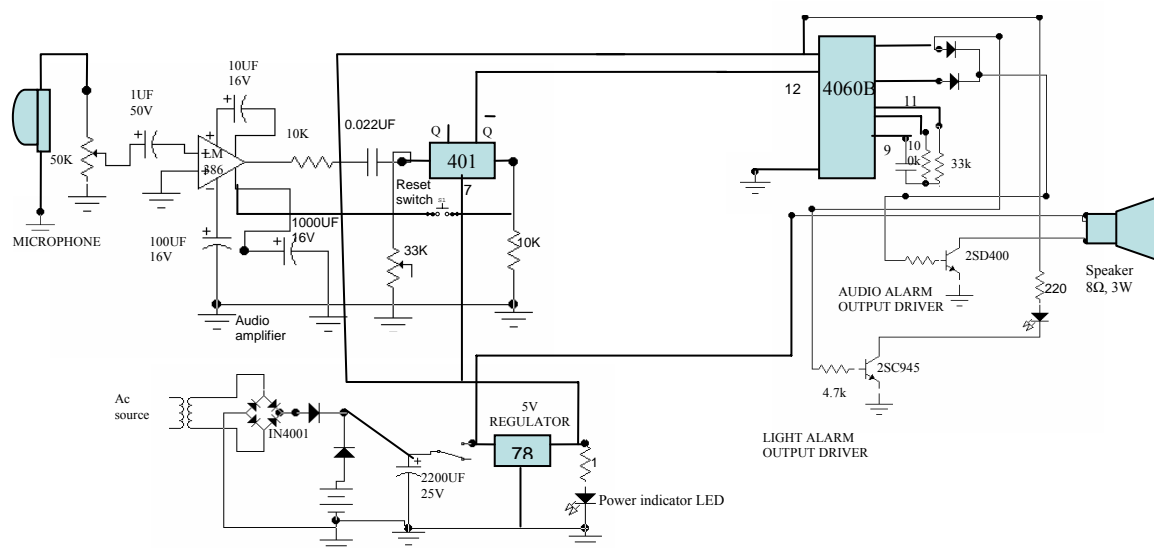


Figure 4. Sound activated burglar alarm circuit

Construction and Testing

The sound activated burglar alarm circuit was constructed in accordance with the circuit designed as illustrated Figure 4. The design was simulated on electronics work bench

[11]. The testing followed the modular pattern used in the design with each functional block being tested as described as follows.

The amplifier stage was tested for the output voltage level, using the millimeters. It was connected to a speaker via a 47 μ F capacitor to a speaker.

The entire circuit was tested for short circuit and open circuit faults that could result into problems. The following results were obtained for distances and sound intensities for which the alarm was triggered. When the microphone was also tapped the alarm was triggered.

Table 1. Alarm test for different sound intensities

ACTIVITY	MAXIMUM DISTANCE (cm)
Clicking of the finger	50
Clapping of the hands	150
Breaking of glass	200
Clanging of metals	223

Conclusion

A simple sound activated burglar alarm system has been designed, constructed and tested. It is suitable for indoor security especially in small rooms, artifacts in museums, jewelry stores and art galleries. This burglar alarm is thus very good for safe guarding valuables.

Recommendations

Like every other work, this work is not without its limitations and can be improved upon. On this basis recommendations have been made for improvement.

To improve the portability of the alarm sensor (microphone), it is recommended that the microphone be separated from the rest of the circuit by incorporating a radio based transmitter and receiver circuit connected to the microphone and the rest of the alarm circuit respectively. The microphone can be connected at the area that needs to be protected while the rest of the alarm circuit can be connected to a security room to alert security personnel. All external wires and cables used within the circuit should be concealed within the building.

For wider coverage in more practical situations, it is recommended that a multi channel amplifier or an exclusive OR gate be used in conjunction with several microphones

placed at strategic locations within the building. It is also recommended for this purpose that an omni directional microphone with higher sensitivity should be used.

A multi channel amplifier with several connections to several speakers can be used to confuse the burglar as to where the sound is coming from.

A connection to a telephone dialer that can dial the security and relay a preprogrammed message with the address of the burglary scene can also be incorporated for better efficiency. A transducer that detects movement and sound can be used can be used to increase the sensitivity and the overall effectiveness of the burglar alarm.

Finally, it is recommended that that provision for a security alarm system should be included in the electrical services design of for every house, industry, office and shops.

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