

Silent Horn System Design

(A Novel Design to avoid the Menence of Horns)

¹Jerbin Joy Kolencheril, ²Jerin C. J.

^{1,2}Dept. of Electronics and Communication, Rajagiri School of Engg. and Tech., Kochi, Kerala, India

Abstract

The purpose of this document is to present an overview into the building of the 'Silent Horn System', that transmits the vehicular horn as an infrared signal, instead of the audible noisy sound. This document provides the block diagram representing the different parts of the circuitry, detailed description of the hardware, circuit diagram and the PCB layout that was used by us. This document concludes by providing merits of the project, followed by suggestions for future development.

The 'Silent Horn System' is an innovation in the existing automobile horn system, developed by us. It uses IR LEDs and TSOPs to transmit and receive Infrared signals as horn. Buzzers are used produce sound inside vehicles to alert the driver.

For making the system compatible with the existing horn system, we have included the normal sound horn with the silent horn. The driver may use any horn, depending on the situation, preferably the silent one. The selection is done by a two level switch. If the user presses on the switch softly, the silent horn is activated, and if a bit more pressure is applied, the sound horn is activated.

If implemented in a wide scale, this project can reduce vehicular noise pollution to a great extent. This system has been found to be very efficient in highways and straight roads.

Keywords

555 Timer IC; TSOP's; EAGLE (Easily Applicable Graphical Layout Editor; Silent Horn

I. Introduction

Vehicular noise, especially the noise produced by horns, is the major cause of noise pollution in urban and in semi urban areas. Horns are used by drivers to alert other drivers in the vicinity. This may disturb the other fellow drivers, passengers, pedestrians, people living nearby, etc. Hypertension and insomnia are some of the diseases caused if sound levels are greater than 120 dB. We have come up with a solution to this issue. Using Simple IR LEDs and receivers, we were successful in generating and transmitting a silent horn signal.

We are going to replace the traditional horn system, with an infrared communication system, that is used in TV remotes. There will be a silent horn button for the driver, to be used by him. This button is similar to those found on a TV remote. When pressed, it will generate an infrared signal, similar to the remote controller, and this signal will be transmitted in all directions outside the vehicle. Sensors similar to those used in television sets, that detect the infrared signal, will be there on all the sides of the other vehicles. These sensors (TSOP1738) are connected to LEDs and buzzers, placed near to the driver seat through logic gates, so that only the required driver is alerted. Only those buzzers are activated, which have been connected to the activated sensors. Thus, sound produced inside the vehicle will be in the same direction in which the horn signal was produced.

II. Basic Working Methodology

This project has a transmitter module and a receiver module. To demonstrate the project, we use two toy cars, one for housing the

transmitter and the other for housing the receiver. This project utilizes simple IR Light Emitting Diodes(LED) as transmitters and TSOP1738 as receivers. TSOP1738 are infrared sensors, that sense infrared light modulated at 38Khz. It is an active low device, and produces bit 0 on receiving IR light. This output is connected to 7400 NAND gates, and the output LEDs/Buzzers are connected to the output of gates. The transistor 2N2222 is used to drive buzzers.

Since the receivers detect only infrared light at 38khz, we need to generate a square wave at the same frequency. This is done by 555 timer IC. Series of IR LEDs are connected to the output of 555 timer to transmit the infrared light in all directions.

III. System Overview: Block Diagram Representation

A. Transmitter

Infrared waves at a particular frequency (38Khz) are created with the help of the 555 Timer IC as shown in Figure 1. The various transmitter components are described below:

1. Power Source

The supply voltage for 555 IC varies from 5V to 15V. Thus we use a 12V DC adaptor directly to power the IC. There is a parallel connection given to the buzzer (sound horn) in the transmitter.

2. Switch section

The switch section is one of the most important parts of the transmitter. It is here that the driver decides whether to use the silent horn or the sound horn. This section is implemented by a two-step switch. It has 2 springs placed one on top of the other, one with a lower spring constant and the other with a higher spring constant. Thus if we apply pressure, the spring with lower spring constant yields first, completing the first connection. If we apply more pressure, the second spring yields down, completing the second connection. The first connection is that of the silent horn and the second connection is that of the sound horn.

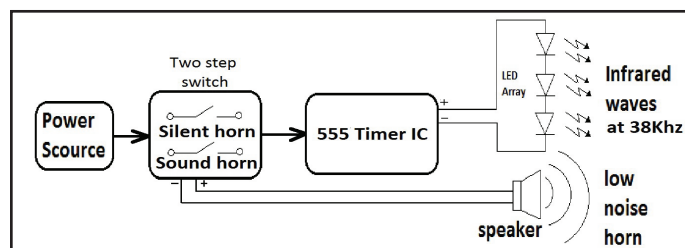


Fig. 1: Transmitter Block Diagram

3. Square Wave Generation

For generating a square wave of frequency 38KHz, we used the 555 timer IC. When supply is provided by the preceding switch section, the IC, that has been designed to work as astable multivibrator, produces a square wave of frequency 38KHz.

4. IR section

For our toy car model, we used 3 sets of 5 IR LEDs, i.e. a total of 15 IR LEDs. Since we were demonstrating a simple model,

we placed first set in the front, second set along the left side and the third set along the right side of the toy car. In each set, we connected the LEDs in series, for better power dissipation through LEDs. A current limiting resistor was also connected at the end of each set. These sets were connected in parallel to the output of the 555 IC.

5. Sound Horn Section

The harder switch in the switch section was connected directly to a buzzer/speaker. This was for the sound horn, which could be used in unavoidable or emergency situations. It also provides a backup in case of malfunction of the silent horn.

B. Receiver

The IR waves at 38Khz are receiver by the TSOP placed on the sides of the car pass through a comparator and combinational circuitry which are then converted into audio signals with buzzers/speakers after amplification. The block diagram of this process is shown in fig. 2.

1. Power Source

There are two power sources used here. The power for the TSOPs, Op Amps and NAND gates is provided by a 5V DC adaptor. We need a higher voltage source to drive the buzzers, and so we used a 12V DC adaptor for the buzzers. The power to TSOPs was given only after filtering, since minor variations in the voltage could prove to be dangerous for the sensor.

2. Sensor Section

Three sets of 3 TSOPs were used to detect the infrared light from the transmitter. Since we were demonstrating a simple model, we placed first set in the rear, second set along the left and the third set along the right side of our toy car. The output was given to the non-inverting terminals of the Op amps for comparator action.

3. Comparator Section

For including comparator circuit, we used LM324. Output of each TSOP is connected to Op amps, i.e., 3 Op amps on each side of the toy car. We get better output waveform when we use comparators instead of direct TSOP outputs. Since LM324 is compatible with TTL standards, it could be directly connected to the NAND gates.

4. Combinational Circuit Section

TSOPs are active low devices. They produce a '0' when they sense the required IR light. Thus, we need to trigger the buzzer when the corresponding TSOP output goes low. This digital function matches with the truth table of NAND gates. So, output of the comparators are connected to NAND gates, i.e., the 7400 IC, and the output of gates are used to drive the buzzers.

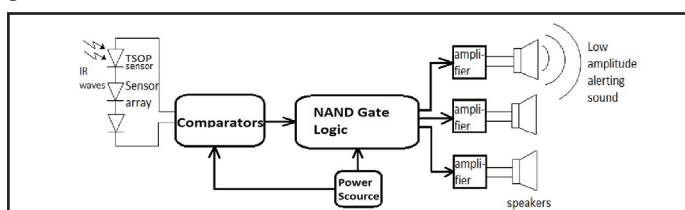


Fig. 2: Receiver Block Diagram

5. Output Section

There are two buzzers along the three sides of our toy car, namely, rear, left and right. Output of each NAND gate is given to the base

of transistor 2N2222. Every buzzer is connected to the collector of a transistor. Thus, one end of buzzer is connected to the collector, and the other end is collected to supply. The emitter is connected to ground.

IV. Hardware Implementation

A. Transmitter

The 12V DC source is connected to the two step switch. Parallel connection is made to the timer IC and the buzzer representing the sound horn. When the switch for silent horn is pressed, current flow starts through 555 IC and a square wave is generated at the output, frequency of which is decided by the external resistors and the capacitors. The output is connected to the sets of IR LEDs, so that when activated, they produce infrared light at a frequency of 38kHz. The sound horn switch is also mounted on the silent horn switch. When the sound horn switch is closed, the connection to the buzzer is completed and a beep is produced.

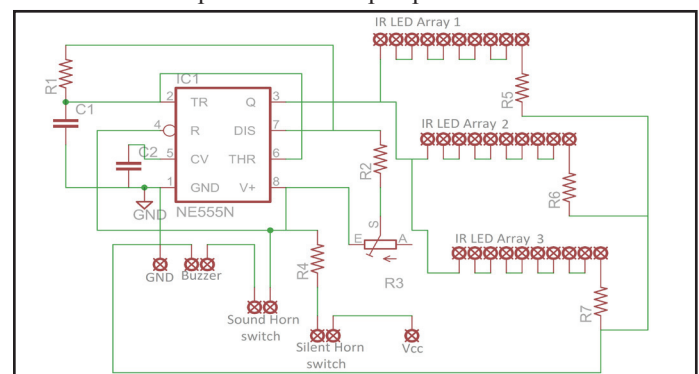


Fig. 3: Transmitter Circuit Diagram – Implemented using EAGLE (Easily Applicable Graphical Layout Editor) by CadSoft

B. Receiver

TSOPs are arranged along the three sides of our toy car, namely, rear left and right. On each side there are 3 TSOPs. Output of each TSOP is given to comparator to refine the output waveform. The outputs of comparator are given to NAND gates. We are using 2 input NAND gates. For three comparator outputs, there are two NAND gates. For the first NAND gate, inputs are outputs of first two comparators. The inputs to second NAND gate are output of the third comparator and the second comparator. Thus output of second comparator is given as input to both the NAND gates. This is because if the second TSOP senses the infrared signals, then output of both the NAND gate of that side should be high.

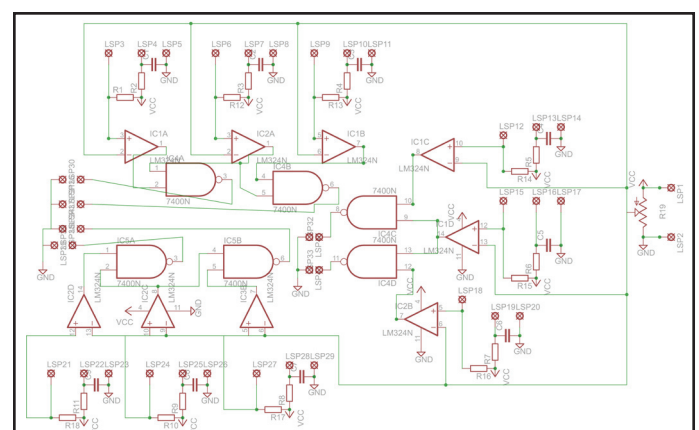


Fig. 4: Receiver Circuit Diagram – Implemented using EAGLE (Easily Applicable Graphical Layout Editor) by CadSoft

The output of each NAND gate is connected to an LED and the base of the transistor 2N2222. The LED will provide visual indication of the direction of the incoming horn signal. Buzzers are connected to the collector of each 2N2222 transistor, to produce audio indication of horn.

V. PCB Layout

A. Transmitter

The PCB layout of the transmitter circuit design is shown below:

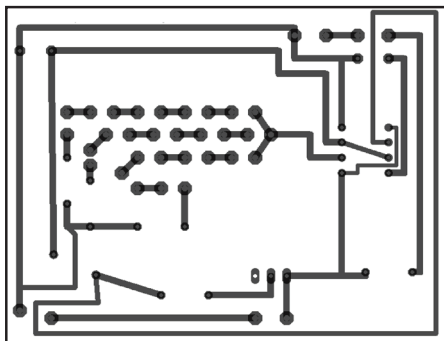


Fig. 5: Transmitter PCB Design (Bottom View) – Implemented using EAGLE (Easily Applicable Graphical Layout Editor) by CadSoft

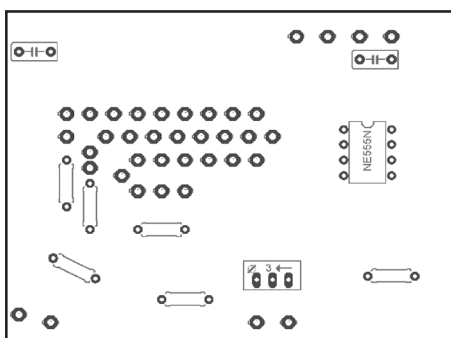


Fig. 6: Transmitter PCB Design (Component view) – Implemented using EAGLE (Easily Applicable Graphical Layout Editor) by CadSoft

B. Receiver

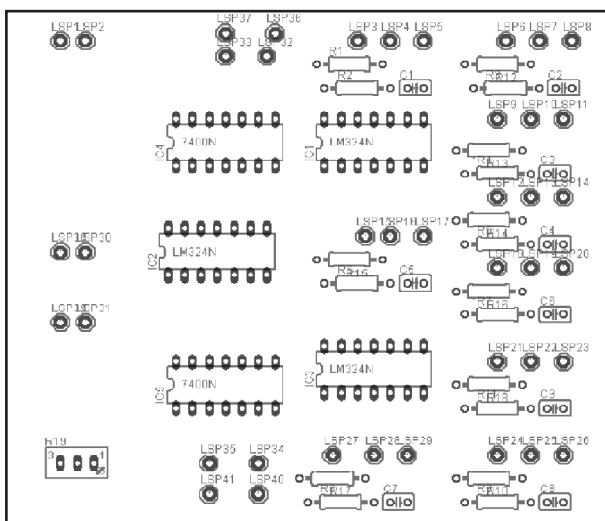


Fig. 7: Receiver PCB Design (Component view) – Implemented using EAGLE (Easily Applicable Graphical Layout Editor) by CadSoft

The PCB layout of the receiver circuitry is shown above.

C. Practical Implementation and Circuit Testing

The PCB circuit was designed and implemented. We prepared a demo of a road system with two toy cars. The transmitter circuit was placed inside one car and receiver circuit was placed inside the other. It was observed that whenever the silent horn button was pressed in a car, the other car responded by producing a sound inside the car. Moreover, the sound produced inside the car was found to be approximately in the same direction in which the other car produced the horn. We placed the receiver car in various angles and configurations with respect to the transmitter car, and observed that the transmitter car produced sound whenever the silent horn button was produced in the other car.

Thus, the 'Silent Horn System' was successfully implemented on PCB. The circuit was tested and was found to be working effectively. The demo model of our project is shown below in fig. 8.



Fig. 8: The Transmitter (Left) and Receiver (Right) implemented on a toy car model. Here when the switch (Horn) is pressed on the transmitter car the infrared signals are transmitted to the second car and the sound is produced in appropriate direction (here apart from buzzers, LED's are used to indicate the direction).

VI. Future Enhancements

The 'Silent Horn System' is a modernization of the existing vehicular horn system. It can thus efficiently replace the old horn system, and help in reducing current noise pollution levels.

Future Enhancements include generalization of the silent horn system to all type of vehicles. Following is the list of enhancements can be added to upgrade the design

- Detection and production of Sound horn
- Transmitting information regarding speed, distance, direction in which the vehicle is about to turn, etc. to other vehicles.
- Transmission of SOS signals to nearby vehicles in case of emergency.
- Obstacle detection
- Collision detection
- Pedestrian detection

VII. Demerits and Problems Faced

Despite the various advantages of the Silent Horn system, It was also found to have some disadvantages.

- The 'Silent Horn system' was found to be not that efficient if it was implemented in a traffic where there is a considerable number of two-wheelers.
- The system works best when roads are straight, due to line of sight communication. It is less efficient in roads that meander.

Problems faced include the following:

- TSOP receiver was not working and there was no change in its output level. First we changed to a component of same rating but with a metal casing that was found to have better

reception. It was also found that each TSOP had its own center frequency, slightly different from its rated 38kHz. For this a resistor pot was introduced in the transmitter circuit to control the frequency at which output is radiated.

- 9V Batteries drained out fast. So a AC-DC adapter was used.

VIII. Acknowledgment

We are grateful to the Almighty God for his blessings and for helping us complete this paper successfully.

We would like to thank Rev. Dr Antony Kariyil CMI, Director, RSET, Kakkanad and Dr J. Issac, Principal, RSET, Kakkanad, for providing us all the necessary facilities including a very well furnished lab. We would also like to thank Prof. Jaison Jacob, HOD, Department of Electronics and Communication, RSET, Kakkanad for his constant and sincere efforts to help us bring out the best that we could. We are also grateful to our guide Mr. Sreekumar, Asst. Professor, Department of Electronics and Communication, RSET, Kakkanad for his valuable and most helpful guidance all through the course of the project.

This acknowledgement would be incomplete without thanking Ms. Harsha A and Mr. Jaison Jacob, Asst. Professors, Department of Electronics and Communication, RSET, Kakkanad for their constant encouragement and support throughout the course of this project. We also thank the technical assistants of the various labs and other teaching staff of the Electronics and Communication Department for their support and valuable inputs.

Referances

- [1] Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall of India, 2008.
- [2] Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata Mc.Graw Hill.