Study the Characteristics of Infrared Based Proximity Sensor Using FM Transmitter

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Abstract — While parking the car the driver should be more careful because the driver cannot see the back of the car while parking or taking reverse, if there is any obstacle and ran over, it might damage the car. Our project will help the person in the driving seat and give alarm if there is any obstacle or a wall while parking or while driving in reverse. The IR sensor will detect the obstacle with in 100cm, if there is any obstacle it will sense and give information to the tone detector which will enable the LM555 timer to generate a PWM for the audio input of the FM Circuit. The LM555 will generate the pulse which helps to produce audio output from the FM Circuit, so that the driver can understand that there is an obstacle. Here we are building a wireless FM transmitter which uses RF communication to transmit the medium or low power FM signal. The maximum range of transmission is around 2 km. FM transmission is done by the process of audio pre amplification, modulation and then transmission. Here we have adapted the same formula by first amplifying the audio signal, generating a carrier signal using an oscillating and then modulating the carrier signal with the amplified audio signal. The amplification is done by an amplifier, whereas the modulation and carrier signal generation is done by a variable frequency oscillator circuit. The frequency is set at anywhere between the FM frequency range from 88MHz to 108MHz. The power of the FM signal from the oscillator is then amplified using a power amplifier to produce a low impedance output, matching that with the antenna. The project consists of an IR transmitter through which rays will be continuously received by IR receiver, which is fed as triggering input to transistor driver circuit. Here we are using DPDT relay. If IR sensor is activated that indicates as buzzer and led to give information that vehicle is present and no space for any other vehicles. This project uses regulated 5V, 750mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the output of secondary of 230/18V step down transformer.

Index Terms—Buffer amplifier, FM Transmission, Frequency modulator, Infrared detector, Proximity sensor, Timer, Tone Detector.

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1. INTRODUCTION

A car parking guard circuit is an intelligent circuit based on detecting obstruction in front a behind the car during parking. While parking the car the driver should be more careful because he cannot see the back of the car while parking or taking reverse, if there is any obstacle and ran over it might be get damage to the car. Achieving an appropriate parking space one big challenge encountered by motorist in the packing yard as the driver spend more time dodging surrounding vehicles and other obstacles in the parking yard. Our project will help the person in the driving seat by giving alarm if there is any obstacle or a wall while parking or while driving in reverse. Here we are building a wireless FM transmitter which uses RF communication to transmit the medium or low power FM signal. The maximum range of transmission is around 2 km. Being low-powered; most transmitters typically have a short range of 100– 300 feet, depending on the quality of the receiver, obstructions and elevation. Typically they broadcast on any FM frequency from 87.5 to 108.0 MHz in most of the world.

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2. METHODOLOGY

2.1 Review Stage

Literature review gives the historical background of the project done earlier and the technical review that briefly describes the essential components used in the circuit diagram for the project.

The first reference to any of the form of detection or notice is the rear view mirrors mounted on the motor vehicle which was introduced in 1914.

Many accidents could be avoided if everyone had car side mirrors and rear view mirrors positioned correctly, eliminating blind spots.

For proper view of the rear part of the car, convex mirrors instead of plane mirrors and concave mirrors where used because they are bent outwards hence providing a full view of traffic behind the car or obstacle.

Our project allows even blind to be able to notice when there is an obstacle at the back without any adjustments to the mirrors or worry that they are going to knock an obstacle.

2.2 Working Principle

While parking the car, the driver should be more careful because someone cannot see the back of the car while parking or taking reverse, if there is any obstacle and ran over it may damage the car. Our project will help the person in the driving seat by notifying him or her by giving an alarm and light display if there is any obstacle or a wall while parking or driving in reverse. The circuit is incorporated with an IR sensor which is used to detect the obstacle within 30cm. If there is an obstacle it will sense and give the signal to the tone detector which will enable the LM555 timer to generate a PWM to the audio input of the FM circuit to create an otput sound so that the driver can understand that there is an obstacle.

2.3 Block Diagram

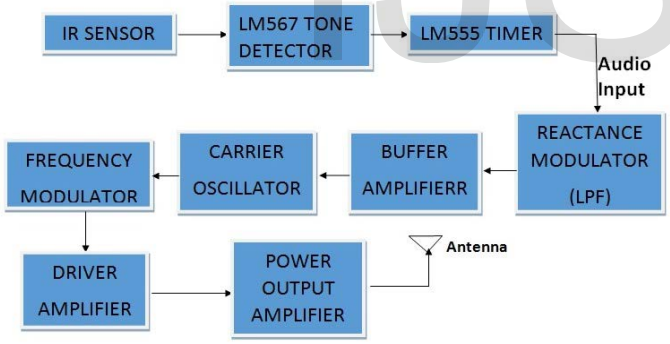

Fig 1: Block diagram of infrared based proximity sensor using FM transmitter.

2.3.1 IR SENSOR

Here, IR Sensor emits in order to sense some aspects of the sourroundings.

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor.

IR Sensor circuit diagram and working principle:

An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time.This circuit comprises of the following components**:**

1. LM358 IC 2 IR transmitter and receiver pair.
2. Resistors of the range of kilo ohms.
3. Variable resistors.
4. LED (Light Emitting Diode).

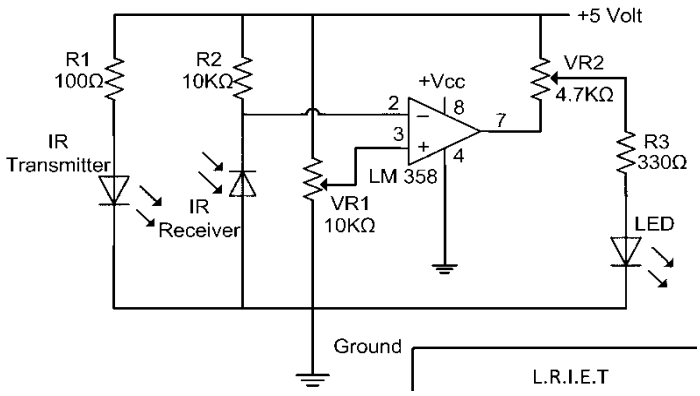

Fig 2: Circuit diagram of IR Sensor.

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram.

2.3.2 LM567 TONE DETECTOR

Here, Tone Detector circuit detects a tone from an audio device such as an mp3 or CD player and can be used to trigger the next component of the circuit i.e. Timer.

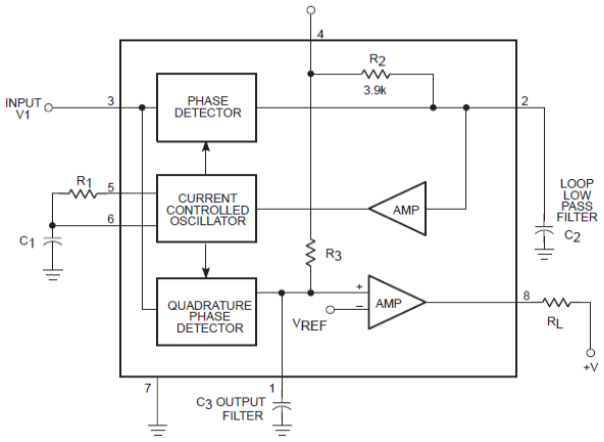

Fig 3: Circuit diagram of Tone Detector.

The LM567 and LM567C are general purpose tone detectors designed to provide a saturated transistor switch to ground when an input signal is present within the passband. The circuit consists of an I and Q detector driven by a voltage controlled oscillator which determines the center frequency of the decoder. External components are used to independently set center frequency, bandwidth and output delay.

Features

1. 20 to 1 frequency range with an external resistor
2. Logic compatible output with 100 mA current sinking capability
3. Bandwidth adjustable from 0 to 14%
4. High rejection of out of band signals and noise
5. Immunity to false signals
6. Highly stable center frequency
7. Center frequency adjustable from 0.01 Hz to 500 kHz

Application

1. Touch tone decoding
2. Precision oscillator
3. Frequency monitoring and control
4. Wide band FSK demodulation
5. Ultrasonic controls
6. Carrier current remote controls
7. Communications paging decoders

2.3.3 LM555 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. Derivatives provide two or four timing circuits in one package.

Features:

1. Direct Replacement for SE555/NE555
2. Timing from Microseconds through Hours
3. Operates in Both Astable and Monostable Modes
4. Adjustable Duty Cycle
5. Output Can Source or Sink 200 mA
6. Output and Supply TTL Compatible
7. Temperature Stability Better than 0.005% per °C
8. Normally On and Normally Off Output
9. Available in 8-pin VSSOP Package

Application:

1. Precision Timing
2. Pulse Generation
3. Sequential Timing
4. Time Delay Generation
5. Pulse Width Modulation
6. Pulse Position Modulation
7. Linear Ramp Generator

2.3.4 FREQUENCY MODULATOR

In telecommunications and signal processing, frequency modulation (FM) is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. This contrasts with amplitude modulation, in which the amplitude of the carrier wave varies, while the frequency remains constant.

Feature:

1. The most important feature of frequency modulation is its resilience to signal level variations. The modulation is carried only as variations in frequency. That is, any signal level variations will not affect the audio output, provided that the signal does not fall to a level where the receiver cannot cope.
2. FM wave has property of resilience to noise and interference. It is for this reason that FM is used for high quality broadcast transmissions.
3. Another important feature is related to FM transmission. It is possible to apply the modulation to a low power stage of the transmitter, and it is not necessary to use a linear form of amplification to increase the power level of the signal to its final value.
4. For FM transmission, it is possible to use non-linear RF amplifiers to amplify FM signals in a transmitter. This is more efficient than the linear RF amplifier Therefore, for a given power output, less battery power is required.

Application:

To generate the FM signal, the frequency of the radio carrier must be changed in line with the amplitude of the incoming audio signal. When the audio signal is modulated on to the radio frequency carrier wave, the new radio waves move up and down in frequency. The rate at which the wave moves up and down is known as Deviation" and is represented as Kilohertz deviation. For example, if the signal wave has a deviation of 4 kHz, then the carrier wave is made to move in 4 kHz.VHF transmission generally uses band between 88 to 108 MHz with large deviation of 75 kHz. This deviation is known as Wide band FM or WBFM. These signals have large bandwidth and support good quality broadcasting. Less band width is used in FM communication systems. Two way communication systems uses Narrow band FM with a deviation of 3 kHz.

2.3.5 BUFFER AMPLIFIER

A voltage buffer amplifier is used to transfer a voltage from a first circuit, having a high output impedance level, to a second circuit with a low input impedance level.

Voltage buffer:

A voltage buffer amplifier is used to transfer a voltage from a first circuit, having a high output impedance level, to a second circuit with a low input impedance level. The interposed buffer amplifier prevents the second circuit from loading the first circuit unacceptably and interfering with its desired operation. In the ideal voltage buffer in the diagram, the input resistance is infinite, the output resistance zero (impedance of an ideal voltage source is zero). Other properties of the ideal buffer are: perfect linearity, regardless of signal amplitudes; and instant output response, regardless of the speed of the input signal.

If the voltage is transferred unchanged (the voltage gain A_v is 1), the amplifier is a unity gain buffer; also known as a voltage follower because the output voltage *follows* or tracks the input voltage. Although the voltage gain of a voltage buffer amplifier may be (approximately) unity, it usually provides considerable current gain and thus power gain. However, it is commonplace to say that it has a gain of 1 (or the equivalent 0 dB), referring to the voltage gain.

As an example, consider a Thevenin source (voltage V_A, series resistance R_A) driving a resistor load R_L. Because ofvoltage division (also referred to as "loading") the voltage across the load is only $V_A R_L / (R_L + R_A)$. However, if the Thévenin source drives a unity gain buffer such as that in Figure 1 (top, with unity gain), the voltage input to the amplifier is V_A, and with *no voltage division* because the amplifier input resistance is infinite. At the output the dependent voltage source delivers voltage $A_v V_A = V_A$ to the load, again without voltage division because the output resistance of the buffer is zero. A Thévenin equivalent circuit of the combined original Thévenin source *and* the buffer is an ideal voltage source V_A with zero Thévenin resistance.

Current buffer:

Typically a current buffer amplifier is used to transfer a current from a first circuit, having a low output impedance level, to a second circuit with a high input impedance level. The interposed buffer amplifier prevents the second circuit from loading the first circuit's current unacceptably and interfering with its desired operation. In the ideal current buffer in the diagram, the output impedance is infinite (an ideal current source) and the input impedance is zero (a short circuit). Again, other properties of the ideal buffer are: perfect linearity, regardless of signal amplitudes; and instant output response, regardless of the speed of the input signal. For a current buffer, if the current is transferred unchanged (the current gain β_i is 1), the amplifier is again a unity gain buffer; this time known as a current follower because the output current *follows* or tracks the input current.

As an example, consider a Norton source (current I_A, parallel resistance R_A) driving a resistor load R_L. Because of current division (also referred to as "loading") the current delivered to the load is only $I_A R_A / (R_L + R_A)$. However, if the Norton source drives a unity gain buffer such as that in Figure 1 (bottom, with unity gain), the current input to the amplifier is I_A, with *no current division* because the amplifier input resistance is zero. At the output the dependent current source delivers current $\beta_i I_A = I_A$ to the load, again without current division because the output resistance of the buffer is infinite. A Norton equivalent circuit of the combined original Norton source and the buffer is an ideal current source I_A with infinite Norton resistance.

2.3.6 REACTANCE MODULATOR

A reactance modulator is a circuit that uses a transistor amplifier that acts like either a variable capacitor or an inductor. When the circuit is connected across the tuned circuit of an oscillator, the oscillator frequency can be varied by applying the modulating signal to the amplifier.

The voltages supplied to both the modulator and oscillator must be carefully stabilized to prevent undesired frequency changes. The speech amplifier does not have to deliver any power and need supply only a small output voltage, say 10 or 15 volts. A pentode and triode, *R-C* coupled, will be sufficient even with a sensitive microphone and a high-powered oscillator. The frequency change of *LC* per volt change on the a.f. grid of the modulator tube will be greater when C_1, Fig. 33 B, is made smaller. The blocking condenser C_2 has a comparatively high value, and hence offers but small reactance to r.f. currents.

3. OPERATIONS OF VARIOUS CIRCUIT PARTS

All the operations are described by figures which are processed as images and their basic descriptions of working principle.

3.1 IR Sensor

An Infrared Sensor (IR Sensor) is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion .These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum all the objectsradiate some form of thermal radiations. These types

of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

An infrared sensor circuit is one of the basic and popular sensor modules in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components.

(I) LM358 IC, 2 IR transmitter and receiver pair.
(II) Resistors of the range of kilo ohms.
(III) Variable resistors.
(IV) LED (Light Emitting Diode).

3.2 LM555 Timer

This circut provides a sample circuit of a 555 timer. This set up provides mono-stable, a-stable and bi-stable modes as well as an in depth discussion of how the 555 timer is a chip that can be used tocreate pulses of various durations, to output acontinuous pulse waveform of adjustable pulse width and frequency, and to toggle between high and low states in response to inputs. By wiring the 555 timer with resistors and capacitors in various ways, you can get to operate in three different modes: Mono-stable Mode is a great for creating time delays. In this mode an external trigger causes the 555 timer to output a pulse of an adjustable duration. A-stable Mode output an oscillating pulse signal/waveform. In this mode the output of the 555 timer is switching between high and low states at a tunable frequency and pulse width. Bi-stable Method causes the 555 timer to toggle its output between high and low states depending on the states of two inputs. Some applications including: (I) A steady clock/trigger to keep time in a circuit, (II) The core oscillator of an analog synthesizer, with the addition of some op amps and the other components this pulse wave can be shaped into a triangle, saw, and even sine shapes (III) A very basis chiptune style noise maker.

3.3 LM567 Tone Detector

The LM567 and LM567C are general purpose tone decoders designed to provide a saturated transistor switch to ground when an input signal is present within the pass band .The circuit consists of an I and Q detector driven by a voltage controlled oscillator which determines the center frequency of the decoder. External components are used to independently set Center frequency, bandwidth and output delay. Some features of LM567 Tone Detector are as follows:

(I) 20 to 1 Frequency Range with an external Resistor.
(II) Logic Compatible Output with 100-mA current sinking Capability.
(III) Bandwidth Adjustable from 0 to 14%.
(IV) High Rejection of out of Band Signals and Noise.
(V) Immunity to False Signals.
(VI) Highly Stable Center Frequency.
(VII) Center Frequency Adjustable from 0.01 Hz to 500 kHz.

4. Conclusion

This integrated circuit has a prime use that is increasing safety of commuters, be it on 2-wheelers, 4-wheelers, heavy transportation vehicles. The current maximum range is 100cm; we are still trying to figure out ways to increase it. People often tend to add bullbars to rear and front bumper which hinders the effectiveness. IR receiver may receive the normal light. As a result, parking sensor may not work properly. We should arrange IR sensors accurately; otherwise they may not detect the obstacle. To conclude this, we would like to say that we made a few efforts to complete as much as possible. Team involvement played a major part in it. Although we couldn't complete as much as we targeted because gathering information and understanding it took longer than expected. We hope to improvise and eliminate all the shortcomings. We are also hopeful that, we will be able to implement the project and we'll use this project in a proper business way as the Entrepreneur.

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