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IMPLEMENTATION, WORKING AND RESULTS OF CIRCUIT DETECTION OF INTRUDERS MOVEMENT USING ULTRASONIC SENSORS

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1. INTRODUCTION

Human, animal or anything can produce sound. This sound is creating by the physical movement whether the movement is fast or slow depends on the medium that create the sound. Eventually these movements can be detected by using an ultrasound sensor. Ultrasonic sound waves are sound waves that are above the range of human hearing and, thus, have a frequency above about 20,000 hertz. Any frequency above 20,000 hertz may be considered ultrasonic.

An ultrasonic sensor typically comprises at least one ultrasonic transducer which transforms electrical energy into sound and, in reverse, sound into electrical energy, a housing enclosing the ultrasonic transducer or transducers, an electrical connection and, optionally, an electronic circuit for signal processing also enclosed in the housing. Ultrasonic sensors have typically been used in applications such as detecting and identifying solid objects, measuring the shape and orientation of a work piece, detecting possible collisions between objects to avoid the collisions, room surveillance, flow measurement, and determining a type of material by measuring the absorption of sound. By combining parts of electronic to the ultrasonic sensor it become an ultrasonic motion detector. A motion detector is an electronic device that detects the physical movement in a given area and transforms motion into an electric signal. The motion detector may be electrically connected to devices such as security, lighting, audio alarms. Motion sensors are used in a wide variety of applications. Motion detectors are mainly used in for security systems.

Now days in the market there are many kind of ultrasonic motion detector sell, basically this project is to design an ultrasonic motion detector use to detect physical movement of human, animal, or anything that move. The design is to improving the use of sensor in detecting motion. Also to reduce the cost to build an ultrasonic motion detector.

2. EXISTING SYSTEM

The ultrasonic motion detector is a project that using an ultrasonic sensor as it's base to detect movement or moving object in small places. It is design to be a low cost ultrasonic motion detector. The transmitter sensor use to generate signal in that area. When the signal is block by moving or movement the receiver will gets the signal and amplifies the signal using transistor. The transistor is use as an amplifier to the receiver circuit. The Led and buzzer in the Circuit use to see if there is movement detect by the sensor. The relay use to trigger another circuit when there is movement detects. The signal generate by the sensor is about ±40khz. This is a fully hardware design project plus it is built to be a portable ultrasonic motion detector.

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3. PROPOSED SYSTEM

This project is design aim and objective is to:

1. To design a circuit that sense motion through movement of anything.
2. The circuit can be used to trigger another circuit whether to on or off depending on the circuit attach to it
3. The design will be a low cost portable motion detector

This project is widely use Depending on situation and places. For this project it is design to meet the following scope

1. Movement will be detected within the coverage area about ±4m.
2. Total beam angle of transmitter and receiver sensor 45º
3. The area of the room is 35m²
4. Condition of room is solid wall

4. HARDWARE DESCRIPTION

The transmitter is a crystal control oscillator build using 4049 hex buffer to drive the transmitter sensor to generate signal continuously. The crystal use to stabilize the level of frequency generate by the transmitter sensor. This is because the transmitter in the figure produces up to 40 KHz in frequency but not in the stable mode. By adding the crystal, when power supply is given the transmitter will start transmitting frequency continuously to the air. The use of capacitor in the circuit is to make as a load capacitance for the crystal. The inverter as we know will provide 180º phase shift from input to output, with additional of R21, R22, C11 and C12 the signal will be add to another 180º phase shift making it equal to 360º loop.

There are many type of transmitter circuit that can be built, but the general concept of the circuit is likely the same.

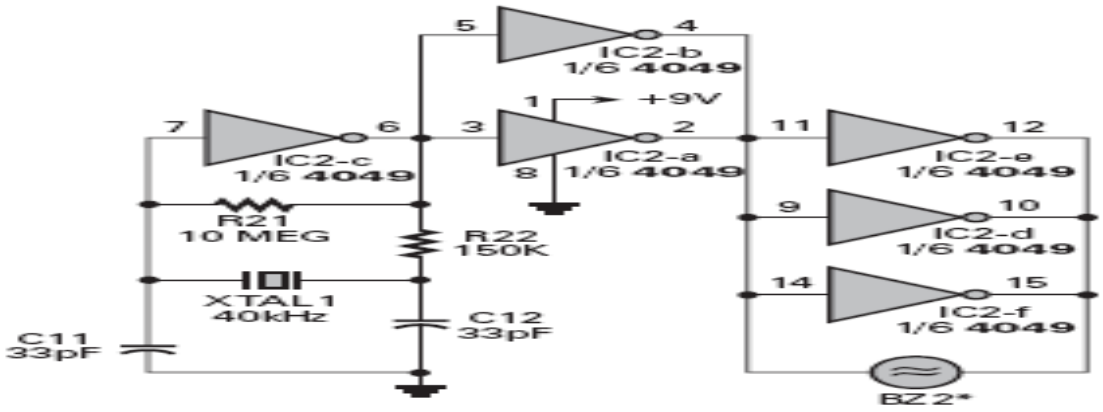

Figure 1: Transmitter circuit

4.1 RECEIVER (BZ1*)

PART A:

This receiver circuit in the figure uses an op-amp as a method to amplify the signal sends by the receiver sensor. It can be divided into three main parts. Each part plays as a different role in the circuit. For part A voltage input R1 and R2 is modulated by the receiver sensor then goes to the first op-amp to be amplified. When there is movement detect by the receiver sensor, the signal will go to the IC1-a to be amplified. Note that the design for the op-amp is a non-inverting concept. As we know it will generate a positive signal by the connection. When there is no movement the signal should just in straight line. The use of diode (D1) and resistor (R8) in the circuit is to act as a negative detector for the signal that has been amplified. When movement occurs the signal is in envelope signal. IC1-b also amplifies the signal and produces a DC level signal for the envelope signal.

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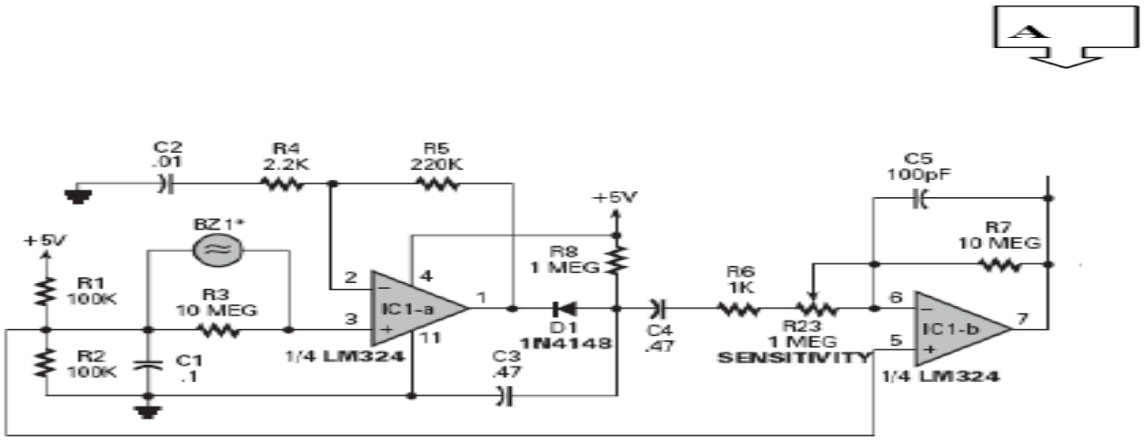

Figure 2: Part A of receiver circuit

PART B:

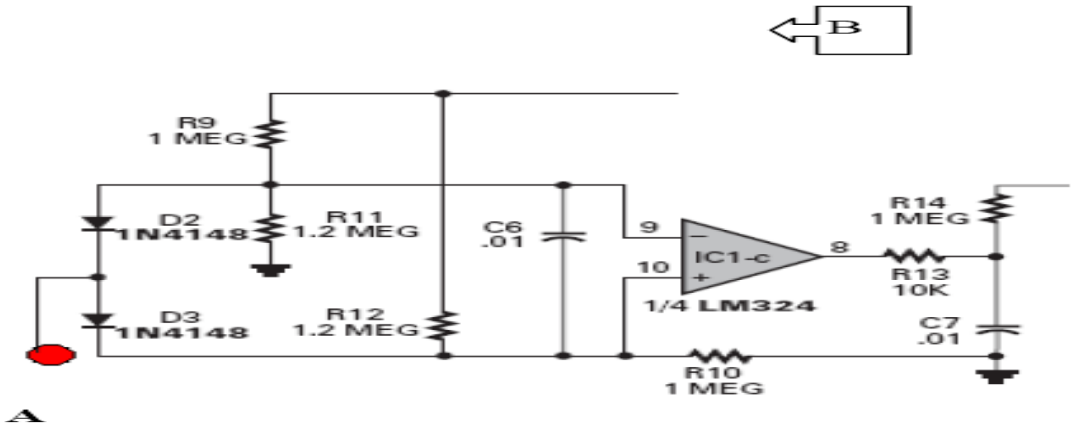

Figure 3: Part B of receiver circuit

As for the next stage of the circuit it comes from point A on figure 2.2,we can see a differential amplifier. D2 and D3 act as positive and negative pulse. When there are no movement, voltage at pin7 of IC1-b is half the supply. When movement detected, signal rise above the forward –biased diode 0.7v making D3 to conduct making pin 8 to go high. But when signal below 0.7v D2 will conduct which we can call as a window detector because it detects voltage to a given range. (Ronald A. Reis, 1997)

PART C:

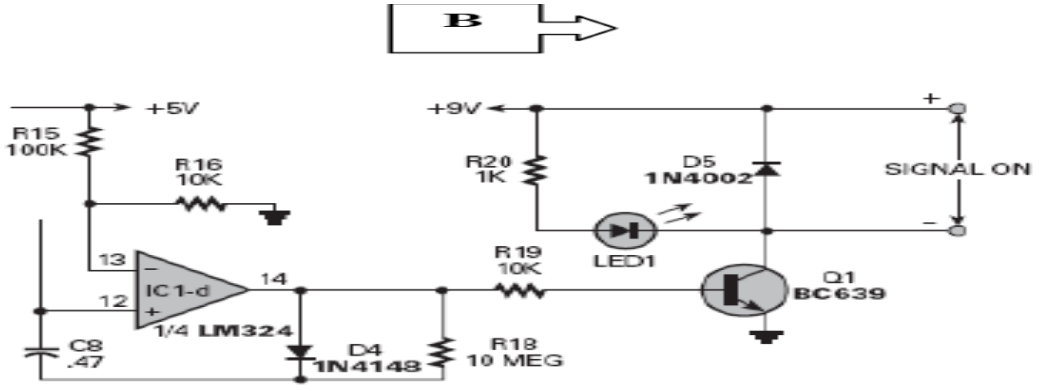

Figure 4: Part C of receiver circuit

In this stage the IC1-d build as a monostable flip flop. The signal comes from point B in figure 2.3. The signal that gets through the process then turn into large pulse enough to turn on the transistor Q1 and the Led will turn 'ON'. (Ronald A. Reis, 1997)

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XTAL:

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is usually use in a wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters. The oscillator circuit is dependent on two key conditions: First, the loop gain needs to be greater than losses around the oscillator loop, or equal to unity. Second, the loop phase shift must be equal to 0 or 360 degrees. Loop phase angle shifts determine the frequency at which the oscillator will operate. A change in net loop phase angle results in a change in output frequency of the oscillator circuit. In order to minimize the net phase shift, a quartz crystal is placed in the feedback loop. The crystal used there in is sometimes called a "timing crystal". On schematic diagrams a crystal is labeled **Y**.

Figure 5: Actual picture of crystal oscillator

5. IMPLEMENTATION AND WORKING

Block Diagram:

Before starting with actual circuit design, we must first understand the basic principles behind the technology that is used this project. The project methodology flow chart is shown below:

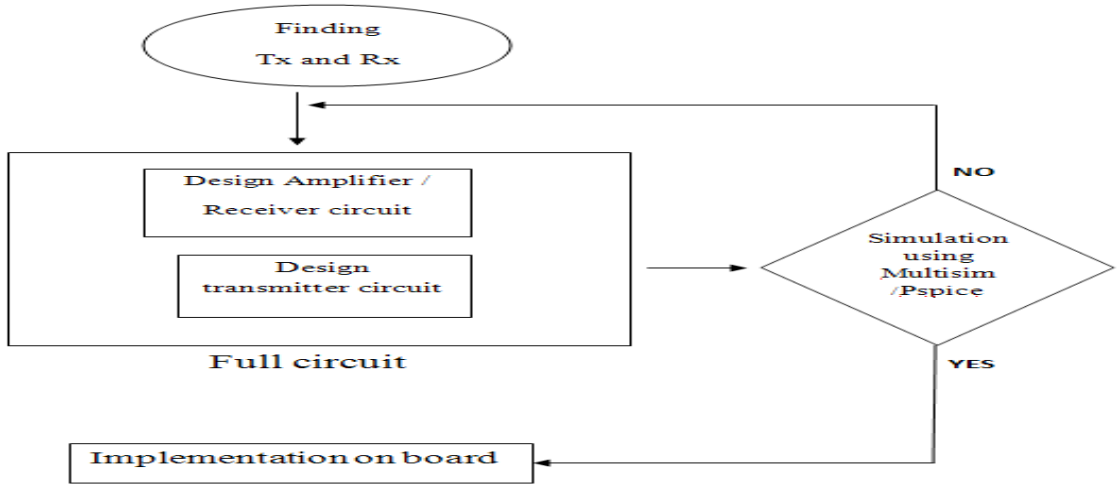

Figure 6: Flow design of the circuit

The flow design of the circuit consist of

1. Finding the right transmitter and receiver sensor for the circuit.
2. Designing the amplifier/receiver circuit
3. Design the transmitter circuit
4. Using simulation to verify the design
5. Implementation on board

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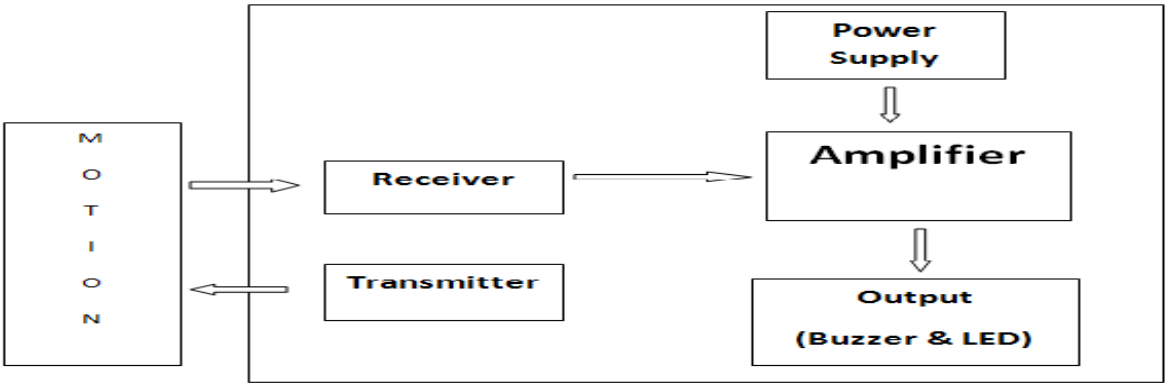

Figure 7: Block Diagram of Motion Sensor Circuit

Operation of the Blocks:

Amplifier Circuit

For the amplifier in this project, the transistor is use to act as amplifier. The basic transistor amplifier circuit is use act as an amplifier method to amplifying. H9013 series of transistor is use because the transistor is the general transistor use in amplifying concept. It is a BJT type of transistor. When the receiver sensor receive signal it will send the signal to the transistor to be amplified. In this project five transistors is use to amplified the signal send by the receiver sensor. The type of design for the transistor is a common emitter amplifier. Base from the design the input signal that come from the base of transistor will be amplified and produce at the collector transistor a larger output signal and the output will be more on positive side signal. Mean that the transistor will amplify current from a small input current to a high output current. It is use also to trigger the relay connected to it. Variable resistor is use to control the level of signal or the sensitivity signal send by the receiver sensor. Mean if no setting are made by the variable resistor the sensor is highly sensitive, even the air counts as a motion parts thus we will get false trigger by the circuit.

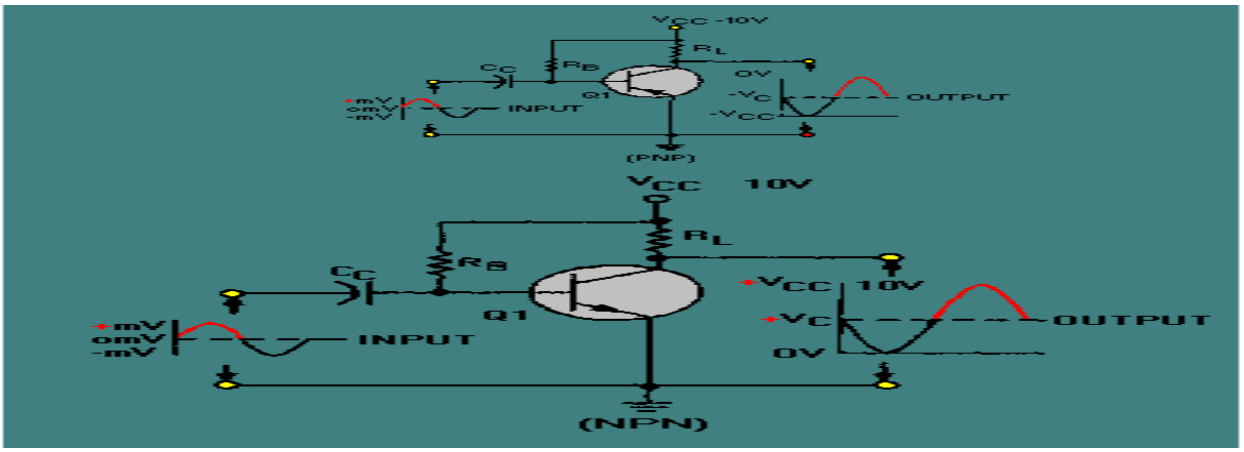

Figure 8: Basic design transistor amplifiers

Hex Buffer Circuit

This circuit consist a buffer, crystal and transmitter sensor in it. The crystal is use to drive the transmitter sensor into a steady frequency stability. It will ring the transmitter to continuous transmitting frequency. A voltage applied across the crystal will cause mechanical movement within the crystal. If an AC voltage is applied across the crystal, the crystal will begin to vibrate. Thus in this circuit it the buffer act as a driver to make sure that the sensor transmit the frequency. The crystal or XTAL is a 40 kHz in frequency. The buffer or hex inverter use in the circuit is single supplies IC mean single supply needed to make it work. It is use to change from high to low level logic conversion. The IC is HD4069UBP hex buffer converter. The supply can be 9Vdc or 12Vdc. It is 14 pin IC. In this project the pin 1 until pin 6 uses for the transmitter sensor to drive the frequency, the other pin use to drive transistor to supply enough current for the relay to energize.

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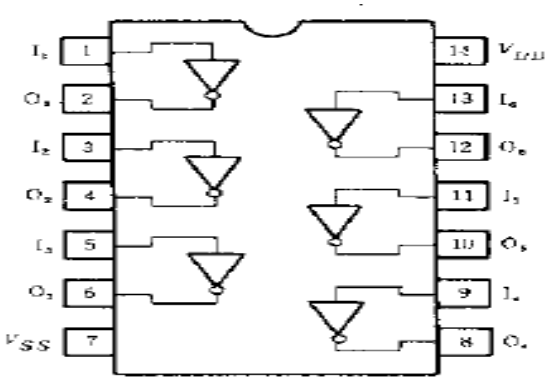

Figure 9: Top view of HD4069UBP buffer IC

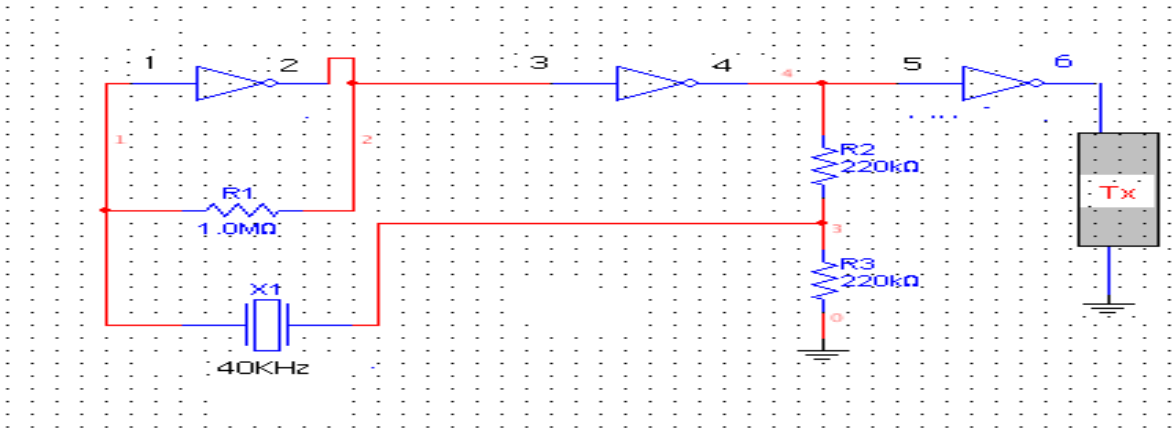

Figure 10: Transmitter Circuit Design

Sensor (Transmitter and Receiver)

Use to transmit and receive signal and send to the circuit. The sensor in this circuit is an ultrasonic sensor. The frequency generate by the sensor ±40kHz. The transmitter and receiver must be equal in frequency to make the circuit function. When power supply is given to the circuit, the transmitter will transform the electrical energy to sound wave and transmit it to the air. Thus when the sound wave or signal is blocking by something or someone, the signal will be detected by the receiver. Crucial thing is finding the right sensor for the right circuit. Moreover the sensor cannot be place to far from each other.

6. RESULTS

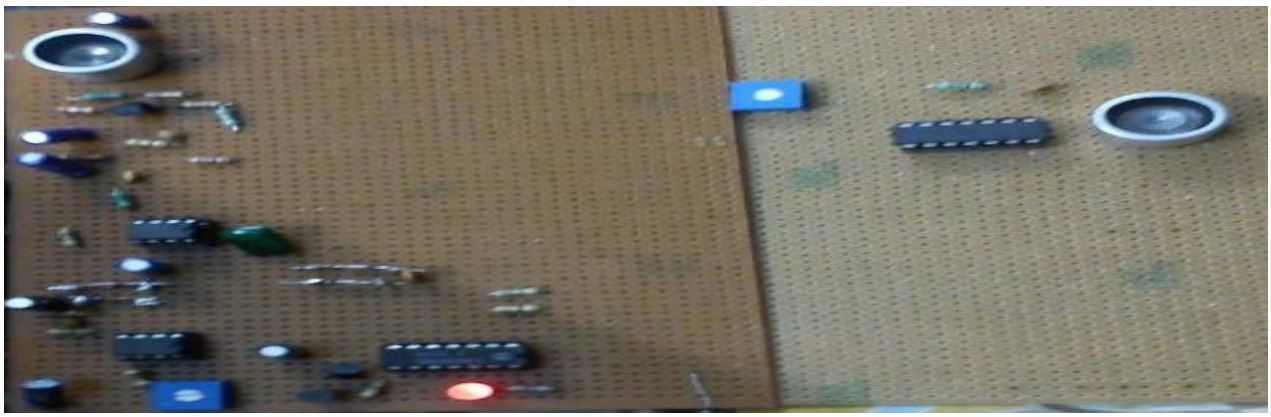

Figure 11: Kit diagram

- How to build your own motion detector
- Video Motion Detectors
- Passive infrared and microwave detectors
- Presence and Absence detection explained
- Comparison of various motion detection technologies

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