A Practical activity Report submitted for

Engineering Design Project-II (UTA-024)

by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY

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PATIALA, PUNJAB

INDIA

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Experiment: 1

Objective:

- To draw a schematic diagram of receiver to receive specified pulse width IR signals from gantries using CAD tool (Eagle).
- To design a printed circuit board layout of receiver circuit using CAD tool (Eagle).

Software Used: Eagle Software

Component Used:

Sr. No	Name of Components	Value	Specifications	Quantity
1.	Resistor	120k Ω	Carbon Resistor with 5% Tolerance	1x
2.	Resistor	100k Ω	Carbon Resistor with 5% Tolerance	1x
3.	Resistor	22k Ω	Carbon Resistor with 5% Tolerance	1x
4.	Resistor	1k	Carbon Resistor with 5% Tolerance	1x
5.	Schottky Diode	BPW41N		1x
6.	Male Header	3-pin	PCB Header	1x
7.	Operational Amplifier	LM311N	Microcontroller	1x

Theory:

1. **Resistor**: A resistor is a passive electrical component with two terminals, designed to limit the flow of electric current in circuits. Its primary function is to reduce current and lower voltage in specific parts of the circuit, as defined by Ohm's Law (V = IR), which relates voltage, current, and resistance. Typically, resistors are made by coiling copper wires around a ceramic rod, with an insulating paint coating for protection. They also use a color-coding system to indicate their resistance value, ensuring accurate application in circuits.

Fig. 1.1 Various types of resistors

2. **Schottky Diode**: A Schottky diode, also called a hot-carrier or Schottky barrier diode, is a metal-semiconductor junction device that plays a crucial role in modern electronic circuits. It is characterized by fast switching and a low forward voltage drop, making it highly efficient and suitable for high-frequency applications and power supplies. Due to its minimal power loss and ability to handle high currents, it is widely used in applications such as radio frequency (RF) systems, photovoltaic systems, and voltage clamping. Its unique design also makes it an excellent choice for rectification in lowvoltage system

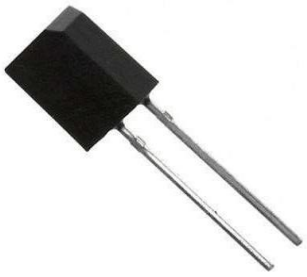

Fig. 1.2 Schottky Diode (BPW41N)

3. **Male Header**: A male header is an electrical connector with one or more rows of metal pins, commonly used to create reliable connections between printed circuit boards (PCBs) and other electronic components. The pins, typically spaced 2.54 mm (0.1 in) apart, are soldered onto a PCB to provide reusable connection points. They are used in breadboard projects, stacking boards, and other electronic applications.

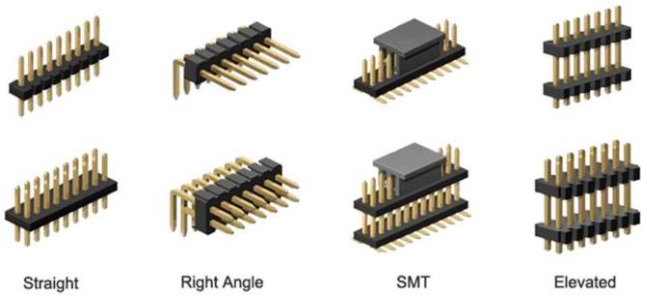

Fig. 1.3 Male PCB Header

4. **Operational Amplifier (LM311N)**: An operational amplifier (op-amp) is a high gain electronic circuit with differential inputs and a single output, designed to amplify voltage differences between its inputs. Made of transistors and resistors, op-amps are fundamental building blocks in analog electronics. They are widely used to amplify signals and perform mathematical operations in various electronic circuits, making them essential components in many applications.

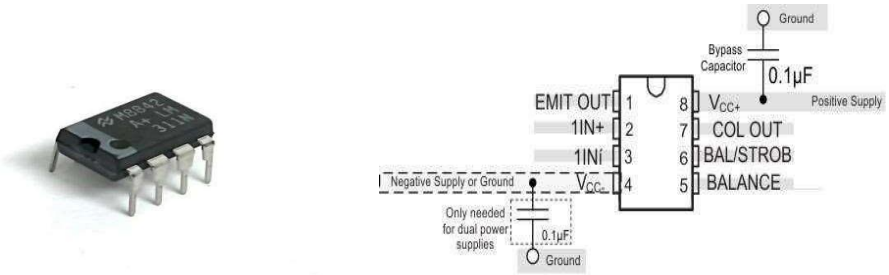

Fig. 1.4 Operational Amplifier (LM311N)

Schematic diagram:

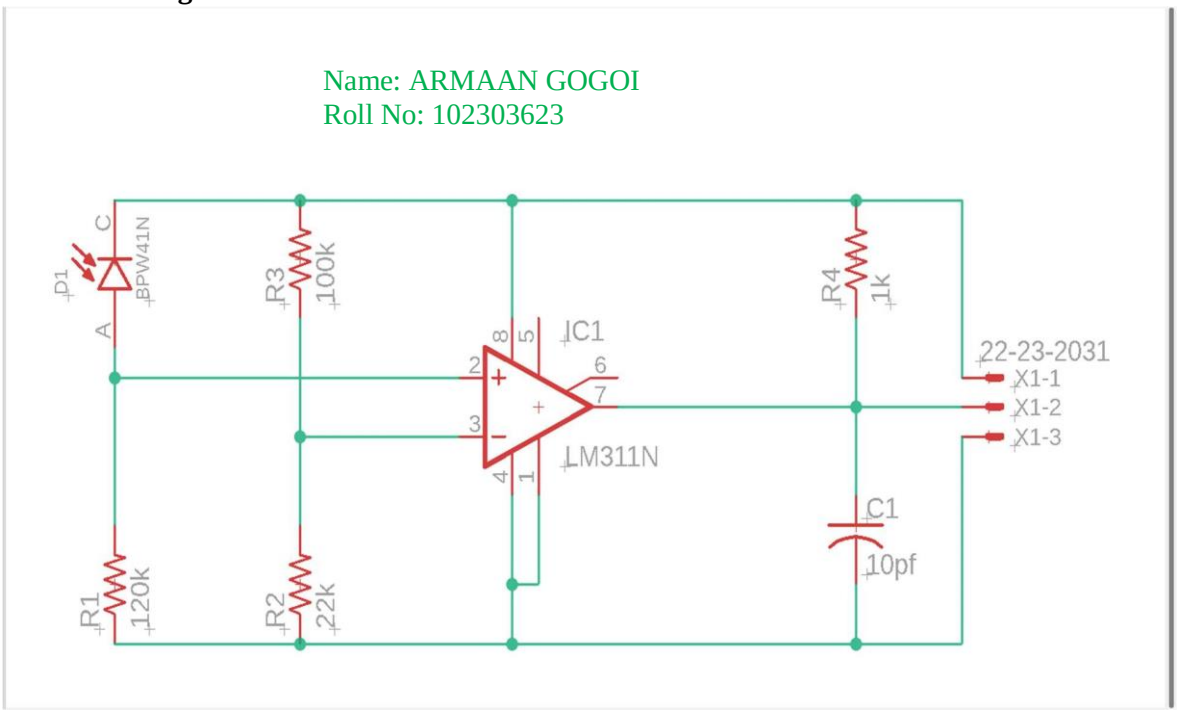

Fig. 1.5 Schematic diagram of Receiver circuit

Printed Circuit Board layout:

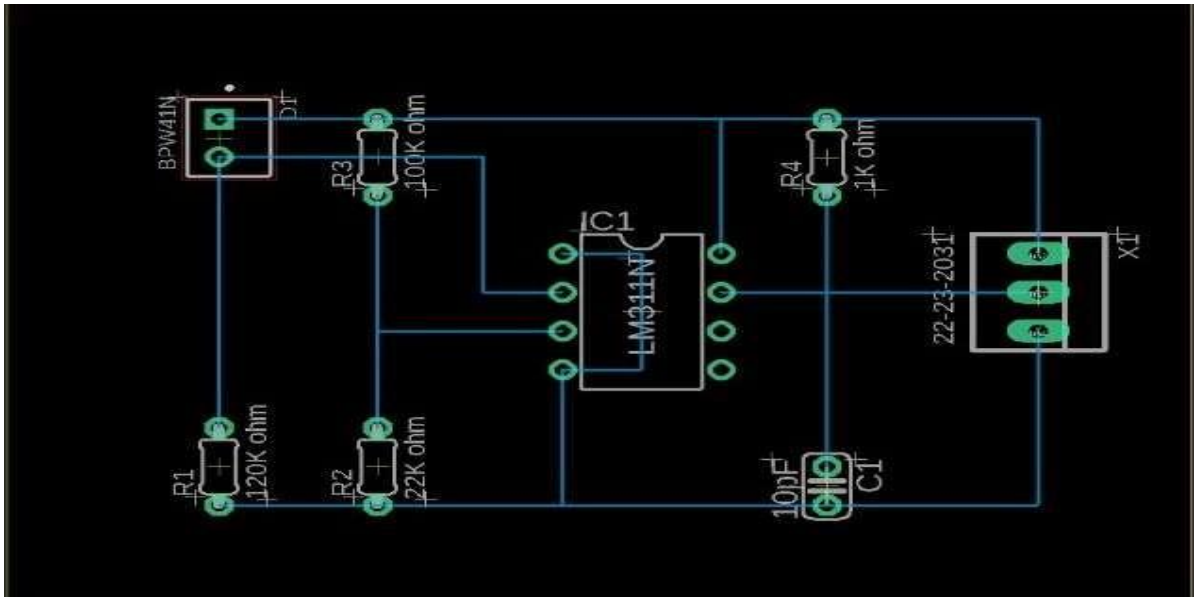

Fig. 1.6(a) PCB layout of Receiver circuit

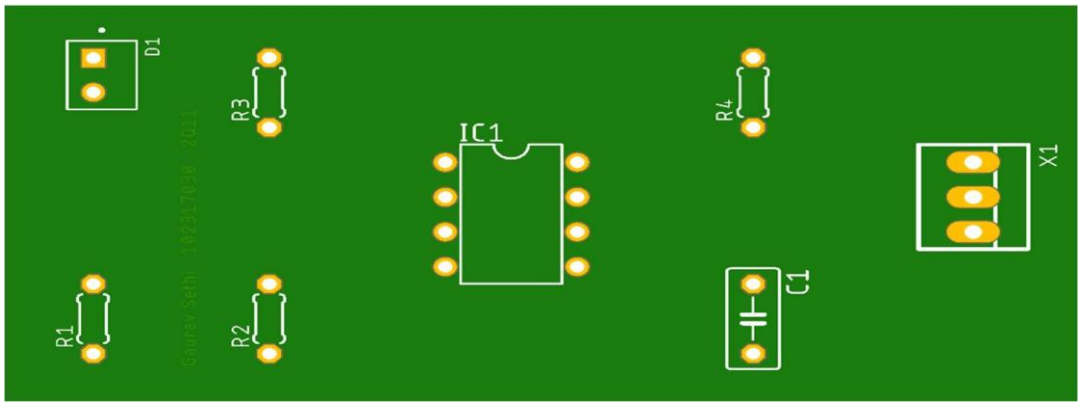

Fig. 1.6(b) Top side PCB view of Receiver circuit

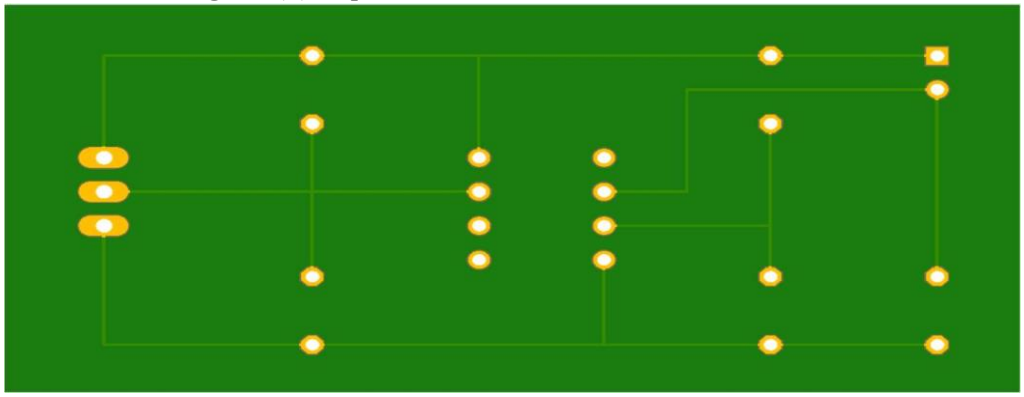

Fig. 1.6(c) Bottom side PCB view of Receiver circuit

Discussion:

In this experiment, we have learned how to design an IR receiver circuit to accurately detect specific pulse-width infrared (IR) signals from gantries. Using Eagle CAD, we created and simulated the schematic diagram and PCB layout, which provided the foundation for precise signal processing in a buggy project. After finalizing the design, the PCB was assembled and tested, confirming its ability to accurately detect the intended IR signals. This experiment provided valuable insights into designing and testing an efficient IR receiver circuit.

Procedure:

- Download and open the Eagle CAD Tool.
- Add the libraries in the software according to the requirements.
- Draw the Schematic Diagram of the circuit by adding the components using “add part” option, searching them by the required specifications or the element's name, and connecting them using the “Net” option.
- We can arrange the components in the circuit using the Rotate, Move, and Mirror options.
- Add the names and values of the components if required.
- After the schematic is ready, click “Move to board” to draw the PCB layout.
- Arrange the components on the PCB correctly according to the schematic in optimized space.
- Use the air route command to make the adequate route of the circuit.
- Then, in the Manufacturing section, fetch the top and bottom view of the PCB layout.

Reference:

[1] https://www.protoexpress.com/kb/basic-components-overview/

[2] https://www.linkedin.com/pulse/resistors-capacitors-inductors-diodes-transistorswhat-you/ [3] https://www.wikipedia.org/

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Signature of Faculty member

Experiment: 2

Objective:

- To draw a schematic diagram of IR sensor module circuit (required to move Buggy module on a predefined the path) using CAD too (Eagle).
- To design a printed circuit board layout of IR sensor module circuit using CAD tool (Eagle).

Software Used: Eagle Software

Component Used:

Sr. No	Name of Components	Value	Specifications	Quantity
1.	Resistor	220 Ω	Carbon Resistor with 5% Tolerance	4x
2.	Resistor	10k Ω	Carbon Resistor with 5% Tolerance	2x
3.	Potentiometer	10k Ω		2x
4.	led3mm	5V	Dome Lamp	2x
5.	IR Transmitter	SFH482		2x
6.	IR Receiver	BPX65	PCB Header	2x
7.	Operational Amplifier	LM358N	Microcontroller	1x

Theory:

1. **Resistor**: A resistor is a passive electrical component with two terminals, designed to limit the flow of electric current in circuits. Its primary function is to reduce current and lower voltage in specific parts of the circuit, as defined by Ohm's Law (V = IR), which relates voltage, current, and resistance. Typically, resistors are made by coiling copper wires around

a ceramic rod, with an insulating paint coating for protection. They also use a color-coding system to indicate their resistance value, ensuring accurate application in circuits.

Fig. 2.1 Resistor

2. **Led3mm**: An LED 3mm is a compact, round light emitting diode with a diameter of 3 millimetres. This semiconductor efficiently converts electrical energy into light and is widely used in electronics for indicators, displays, and various projects due to its reliability and durability.

Fig. 2.2 Various types of sub miniature standard LED3mm

3. **IR Transmitter (SFH482)**: The SFH482 is an infrared (IR) transmitter used to convert electricity into invisible IR radiation with a peak wavelength of 880nm. It is made from GaAIAs and comes in a compact TO-1 8 package. The LED has a minimum operating temperature of 40 ^{0} C and a maximum of 125 ^{0} C, with a forward current rating of 1 00mA and a forward voltage rating of 1 .5V. The shorter pin is negative, while the longer pin is positive in nature. It is widely used in remote controls, data transmission and sensing

applications. The compact size and reliable performance make it suitable for both industrial and consumer electronics.

Fig. 2.3 IR Transmitter (SFH482)

4. **IR Receiver (BPX65)**: The BPX65 is an infrared (IR) receiver used to detect invisible IR light and convert it into an electrical signal. It is designed with a photodiode that ensures accurate and reliable detection of IR radiation, making it suitable for a variety of applications. The BPX65 is highly sensitive, with a peak sensitivity wavelength of around 950nm, allowing it to detect even low-intensity IR signals effectively. Additionally, it operates efficiently over a wide range of distances, providing flexibility in system design. Commonly found in remote control systems, it receives IR signals emitted by devices like TVs, air conditioners, and other appliances, enabling seamless communication between the transmitter and receiver.

Fig. 2.4 IR Receiver (BPX65)

5. **Potentiometer**: A potentiometer is a variable resistor that controls the electrical resistance in a circuit. It consists of a long wire, divided into sections and connected to a thick metal strip,

with resistance adjustable via a rheostat. The working principle of a potentiometer is that the potential drop across any section of the wire is directly proportional to its length, provided the wire has a uniform cross-sectional area and a constant current flow through it. Potentiometers are commonly used to measure unknown voltages by comparing them with known voltages, offering more accuracy than other methods. They are also useful for determining the emf and internal resistance of cells.

Fig. 2.5 Potentiometer

6. **Operational Amplifier (LM358N)**: The LM358N is a dual operational amplifier (op-amp) commonly used in various electronic circuits. It features two independent, high-gain, internally compensated op-amps in a single package, making it ideal for tasks such as amplification, filtering, and voltage comparison. It operates from a single power supply over a wide voltage range, which adds to its versatility in different applications. It is known for its low power consumption and is widely used in audio, sensor interfacing, and analog signal processing applications. The op-amps ability to amplify the voltage difference between inverting and noninverting inputs using differential input transistors makes it highly reliable for precise signal processing.

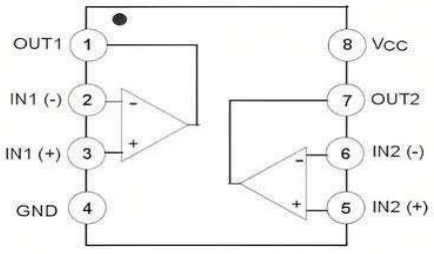

Fig. 2.6 Operational Amplifier (LM358N)

Schematic diagram:

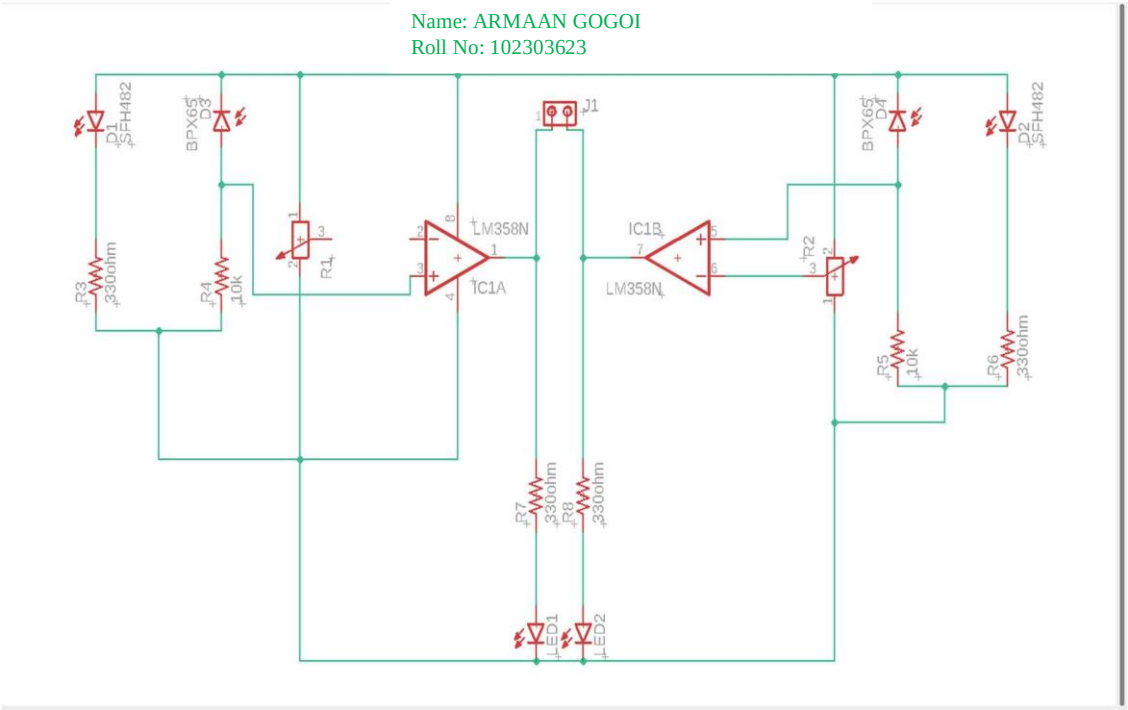

Fig. 2.7 Schematic diagram of IR circuit

Printed Circuit Board layout:

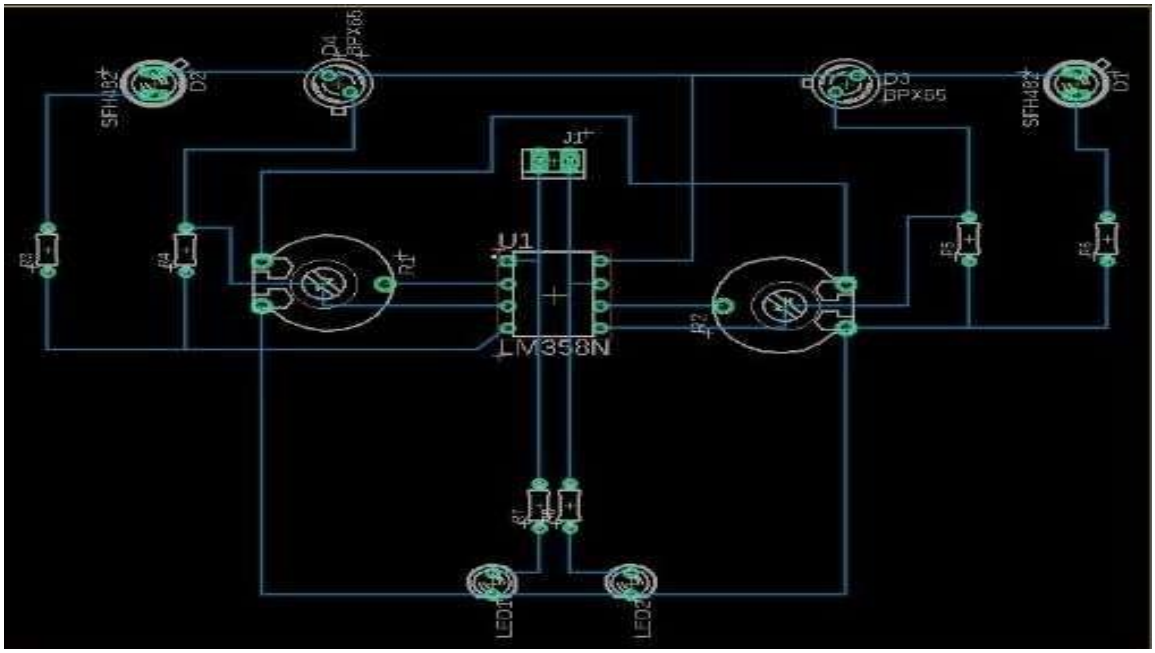

Fig. 2.8(a) PCB layout of IR circuit

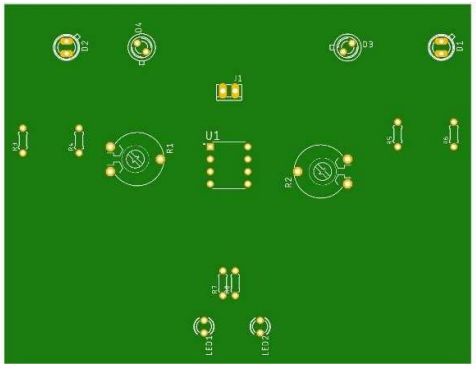

Fig. 2.8(b) Top view of PCB of IR circuit

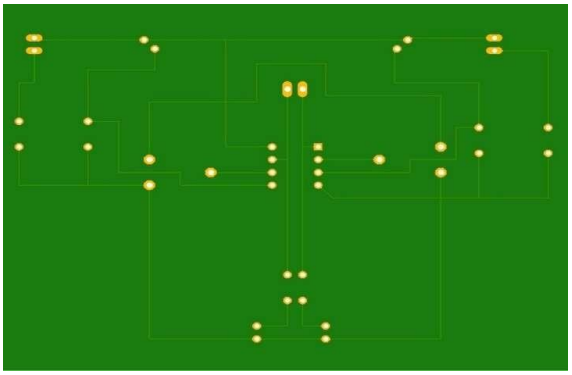

Fig. 2.8(c) Bottom view of PCB of IR circuit

Discussion:

In this experiment, an IR sensor module circuit was designed to guide a buggy along a predefined path using IR emitters, detectors, and signal conditioning components. A detailed schematic, created using Eagle CAD, depicted the interconnection of sensors, resistors, capacitors, and necessary microcontrollers. The PCB layout was optimized for component placement, trace routing, and grounding to ensure accurate functionality and minimize interference.

Procedure:

- Download and open the Eagle CAD Tool.
- Add the libraries in the software according to the requirements.
- Draw the Schematic Diagram of the circuit by adding the components using "add part" option, searching them by the required specifications or the element's name, and connecting them using the "Net" option.
- We can arrange the components in the circuit using the Rotate, Move, and Mirror options.
- Add the names and values of the components if required.
- After the schematic is ready, click "Move to board" to draw the PCB layout.
- Arrange the components on the PCB correctly according to the schematic in optimized space.
- Use the air route command to make the adequate route of the circuit.
- Then, in the Manufacturing section, fetch the top and bottom view of the PCB layout.

Reference:

[1] https://www.protoexpress.com/kb/basic-components-overview/

[2] https://www.linkedin.com/pulse/resistors-capacitors-inductors-diodes-transistorswhat-you/

[3] https://www.geeksforgeeks.org/potentiometer-definition-working-principle-types/

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Experiment: 3

Objective:

- To draw a schematic diagram of pulse width modulation (PWM) based transmitter for generating specified pulse width waveforms for gantries placed at different locations on the path using CAD tool (Eagle).

- To design a printed circuit board layout of pulse width modulation (PWM) based transmitter using CAD tool (Eagle).

Software Used: Eagle Software

Component Used:

Sr. No	Name of Components	Value	Specifications	Quantity
1.	Resistor	0 Ω	Carbon Resistor with 5% Tolerance	1x
2.	Capacitor	10uF	Electrolytic Capacitor	1x
3.	Capacitor	10pF	Ceramic Capacitor	1x
4.	DCJ0202	NA	DC Power Jack	1x
5.	Led3mm	5V	Dome Lamp	1x
6.	IC 7805T	5V	Positive Voltage Regulator	1x
7.	22-23-2031	NA	PCB Header	1x
8.	ATTINY85	NA	Microcontroller	1x

Theory:

1. **Capacitor**: A capacitor is a passive electronic component that stores electrical energy in an electric field. It consists of two conductive plates separated by an insulating material called a

dielectric. When a voltage is applied across the plates, an electric charge accumulates on them, creating a potential difference. Capacitors are widely used in electronic circuits for various purposes, such as filtering, energy storage, and coupling or decoupling signals. The amount of charge a capacitor can store is determined by its capacitance, measured in farads (F), which depends on the size of the plates, the distance between them, and the properties of the dielectric material. They play a crucial role in timing circuits, power supplies, and signal processing.

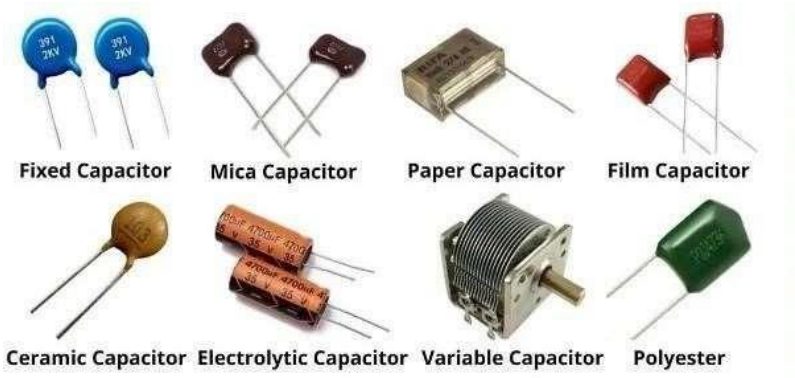

Fig. 3.1 Various types of capacitors

2. **IC 7805T**: The IC 7805T is a voltage regulator that provides a stable 5V DC output from a higher input voltage, typically ranging from 7V to 35V. It is a member of the 78xx series of linear voltage regulators, commonly used in electronic circuits to power microcontrollers, sensors, and other components requiring a consistent 5V supply. The IC features built-in thermal shutdown, current limiting, and short-circuit protection to ensure safe operation. Its three-terminal design (input, ground, and output) makes it easy to integrate into circuits, and it often requires only a few external capacitors for noise filtering. Widely used in power supplies, the 7805T is reliable, cost-effective, and easy to implement.

Fig. 3.2 Voltage regulator 7805T

3. **ATTTINY85**: The ATtiny85 is a compact and versatile 8bit microcontroller from Microchip's AVR series, designed for small-scale projects. It features 8 KB of flash memory, 512 bytes of RAM, and 51 2 bytes of EEPROM, making it suitable for applications with limited resource requirements. With six I/O pins, it supports functionalities like PWM, ADC, SPI, and 12C, enabling control of sensors, LEDs, and communication modules. Operating at clock speeds of up to 20 MHz, the ATtiny85 is ideal for embedded systems, wearable devices, and IOT projects. Its small size and low power consumption make it a popular choice for minimalistic designs.

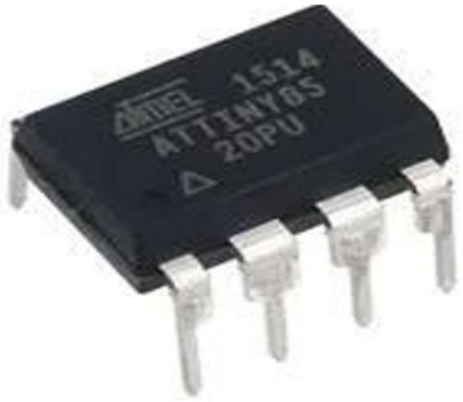

Fig. 3.3 IC ATTINY85

4. **DCJ0202**: The DCJ0202 is a common barrel-type power connector used in electronic devices like routers, modems, and portable gadgets. It features a cylindrical shape with a hollow center for the power pin and is designed for low to medium power applications. These connectors are available in standard sizes, typically with a 5.5mm outer diameter and 2.1 mm or 2.5mm inner diameter, and include polarity markings to prevent reverse connections. Known for their reliability and ease of use, they are widely used in power supplies for small electronics.

Fig. 3.4 IC DCJ0202

5. **22-23-2031(MTA02-100)**: The 22-23-2031 is a wire-to-board connector with a 2.54 mm (0.1 inch) pitch, part of the MTA (Mass Termination Assembly) series. It is typically available in a 3-position configuration, enabling the connection of three wires to a printed circuit board (PCB). Designed for quick and reliable assembly, it often uses IDC (Insulation Displacement Contact) technology, eliminating the need for soldering. This connector is widely used in applications such as computers, communication equipment, and industrial devices to ensure secure and durable connections between wires and circuit boards.

Fig. 3.5 Series female wire connector

6. **Resistor**: A resistor is a passive electrical component with two terminals, designed to limit the flow of electric current in circuits. Its primary function is to reduce current and lower voltage in specific parts of the circuit, as defined by Ohm's Law (V = IR), which relates voltage, current, and resistance. Typically, resistors are made by coiling copper wires around a ceramic rod, with an insulating paint coating for protection. They also use a color-coding system to indicate their resistance value, ensuring accurate application in circuits.

Fig. 3.6 Various types of resistors

7. **Led3mm**: An LED 3mm is a compact, round light emitting diode with a diameter of 3 millimetres. This semiconductor efficiently converts electrical energy into light and is widely used in electronics for indicators, displays, and various projects due to its reliability and durability.

Fig. 3.7 Various types of sub miniature standard LED3mm

Schematic diagram:

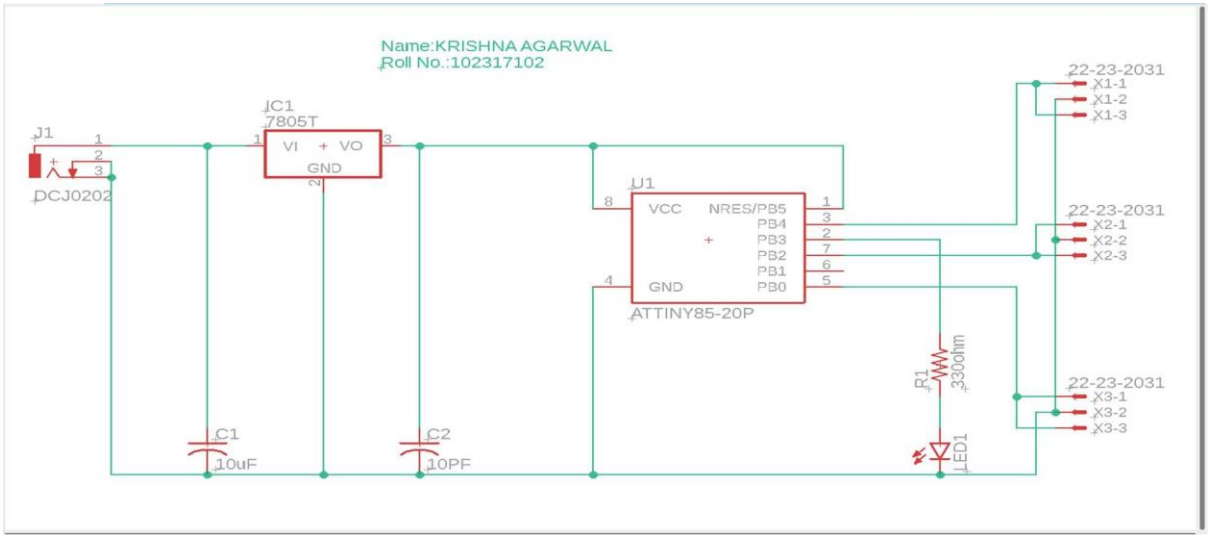

Fig. 3.8 Schematic diagram of Transmitter circuit

Printed Circuit Board layout:

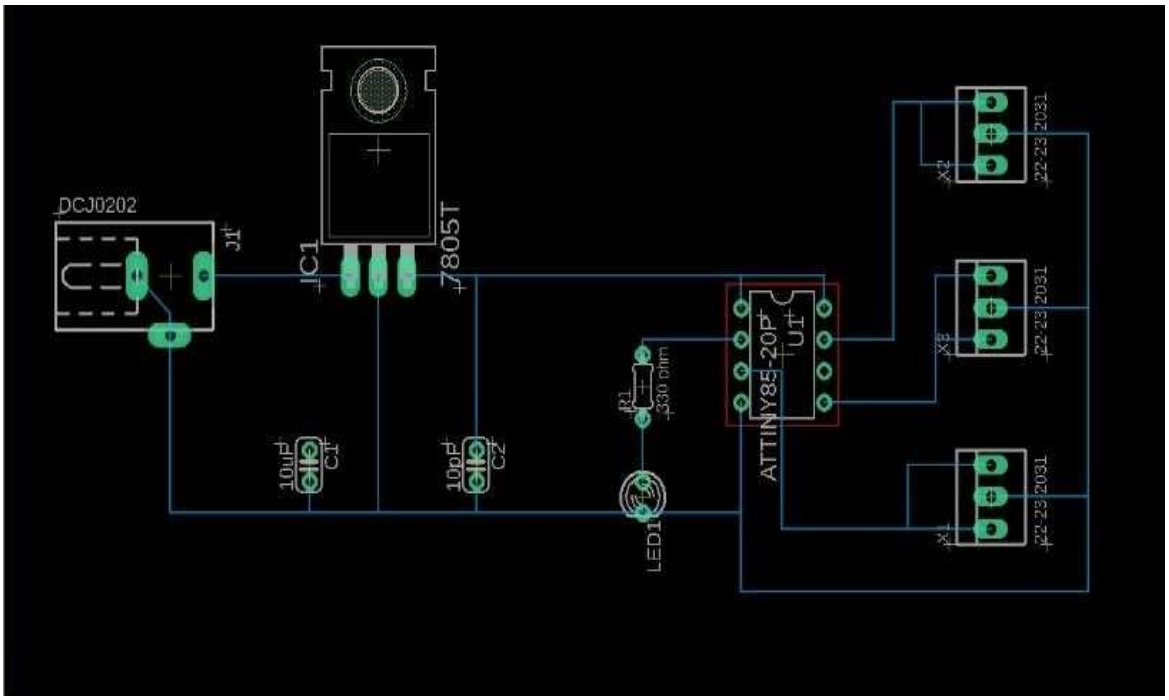

Fig. 3.9(a) PCB layout of Transmitter circuit

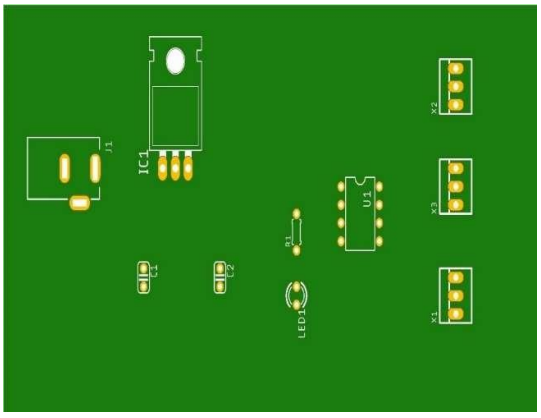

Fig. 3.9(b) Top side view of Transmitter circuit

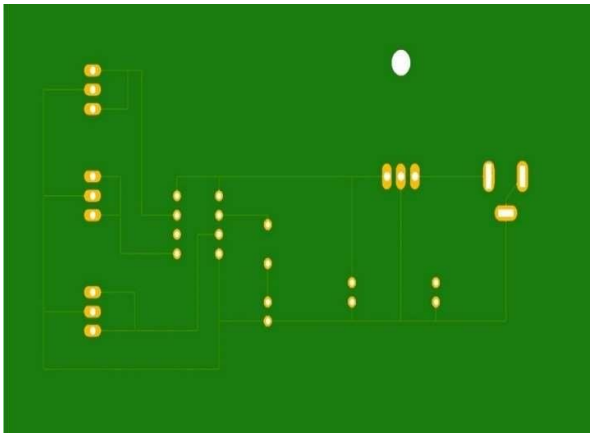

Fig. 3.9(c) Bottom side view of Transmitter circuit

Discussion:

In this experiment, we created a PWM-based transmitter circuit to generate precise control signals for synchronized movement in systems like gantries. Using Eagle CAD, we designed the schematic to connect components like the microcontroller, PWM generator, and output drivers, and optimized the PCB layout for better component placement and signal integrity.

Procedure:

- Download and open the Eagle CAD Tool.
- Add the libraries in the software according to the requirements.
- Draw the Schematic Diagram of the circuit by adding the components using "add part" option, searching them by the required specifications or the element's name, and connecting them using the "Net" option.
- We can arrange the components in the circuit using the Rotate, Move, and Mirror options.
- Add the names and values of the components if required.
- After the schematic is ready, click "Move to board" to draw the PCB layout.
- Arrange the components on the PCB correctly according to the schematic in optimized space.
- Use the air route command to make the adequate route of the circuit.
- Then, in the Manufacturing section, fetch the top and bottom view of the PCB layout.

Reference:

[1] https://www.electronicsforu.com/technology-trends/learn-electronics/7805-voltageregulator

[2] https://www.linkedin.com/pulse/resistors-capacitors-inductors-diodes-transistors-what-you/

[3] https://www.protoexpress.com/kb/basic-components-overview/

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