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5	To draw a schematic diagram of IR sensor module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Autodesk Eagle software.
6	To design a printed circuit board layout of IR sensor module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Autodesk Eagle software.

Objective:

1. 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).
2. To design a printed circuit board layout of pulse width modulation (PWM) based transmitter using CAD tool (Eagle).
3. **Software Used:** Eagle Software
4. **Component Used:**

Sr. No	Name of Components	Value	Specifications
1.	Resistor	220 Ω	Carbon Resistor with 5% Tolerance
2.	Capacitor	1000nF	Electrolytic Capacitor
3.	Capacitor	10nF	Electrolytic Capacitor
4.	DCJ0202		DC Power Jack
5.	HLMP6	5V	Dome Lamp
6.	IC 78L05Z	+5V	Positive Voltage Regulator
7.	22-23-2031		PCB Header
8.	PIC12F629		Microcontroller

Theory:

1. **Resistor**: Resistors are electronic components that implement electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

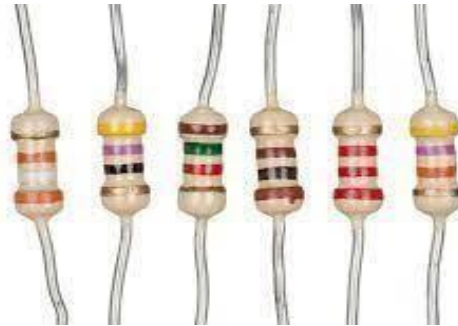


Fig. 1.1 Various types of resistors

2. **Capacitor**: The capacitor is a component which stores electrical energy in an electric field. It is a passive electronic component with two terminals. A capacitor consists of two conductors separated by a non-conductive region. The effect of a capacitor is known as capacitance.

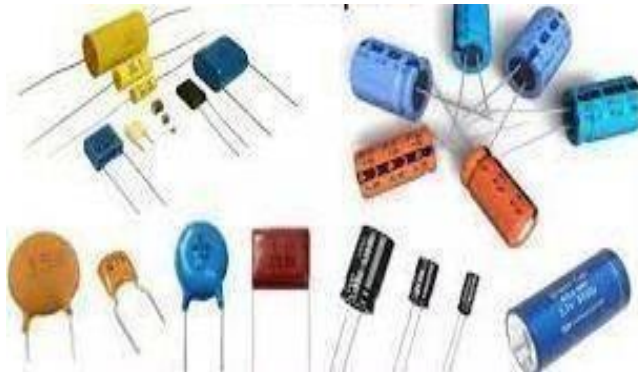


Fig. 1.2 Various types of capacitors

3. **HLMP6**: HLMP 6 is a sub miniature standard red LED lamp with tinted/diffused lens. The dome lamp is used as indicator, it uses a tinted/diffused lens to provide a wide viewing angle with a high ON-OFF contrast ratio. This device is made by encapsulating LED chips on axial lead frames to form moulded epoxy sub miniature lamp package.



Fig. 1.3 Various types of sub miniature standard LED

4. **IC 78L05Z**: 78L05Z is a fixed positive voltage regulator with a fixed output voltage of 5V which is useful in a wide range of applications. 7805 is a three-terminal device with the three pins being 1. INPUT, 2. GROUND and 3. OUTPUT.



Fig. 1.4 Voltage regulator 78L05Z

5. **PIC12F629**: PIC12F629 is a powerful easy to program CMOS. PIC12F629 is an **eight-pin 8bit PIC Microcontroller** with an operating voltage from 2V to 5.5V. It has 128 bytes of EEPROM with 4 internal oscillator configurations up to 4MHz (RC oscillator) with poweronreset. It also has two timers (8bit and 16-bit) and one comparator.

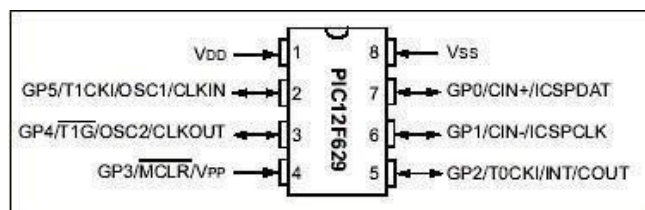




Fig. 1.5 IC PIC12F629

6. **DCJ0202**: This is a component used in many electronic devices that allows a steady power source to be plugged in. Unlike AC plugs, which are uniform and regulated on a country-by-country basis, DC jacks and plugs, which are technically referred to as coaxial power connectors, are generally not standardized.



Fig. 1.6 IC PIC12F629

7. **22-23-2031**: 22-23-2031 is a 2.54 mm pitch wire to board connectors. It incorporates offset header entry holes that provide +180°C polarization and allows both power and signal to carry through the same housing. This connector system also allows loading with optional polarization keys and pegs that ensures one way mating of headers and housings.

8. PCB Board: Printed circuit boards (PCBs) are the foundational building block of most modern electronic devices. Whether simple single layered boards used in your garage door opener, to the six layer board in your smart watch, to a 60 layer, very high density and highspeed circuit boards used in super computers and servers, printed circuit boards are the foundation on which all of the other electronic components are assembled onto.



Fig. 1.8 PCB Board

9. Soldering Station: A soldering station is a multipurpose power soldering device designed for electronic components soldering. This type of equipment is mostly used in electronics and electrical engineering. Soldering station consists of one or more soldering tools connected to the main unit, which includes the controls (temperature adjustment), means of indication, and may be equipped with an electric transformer. Soldering stations may include some accessories – holders and stands, soldering tip cleaners, etc. Soldering stations are widely used in electronics repair workshops, electronic laboratories, in industry.



Schematic diagram:

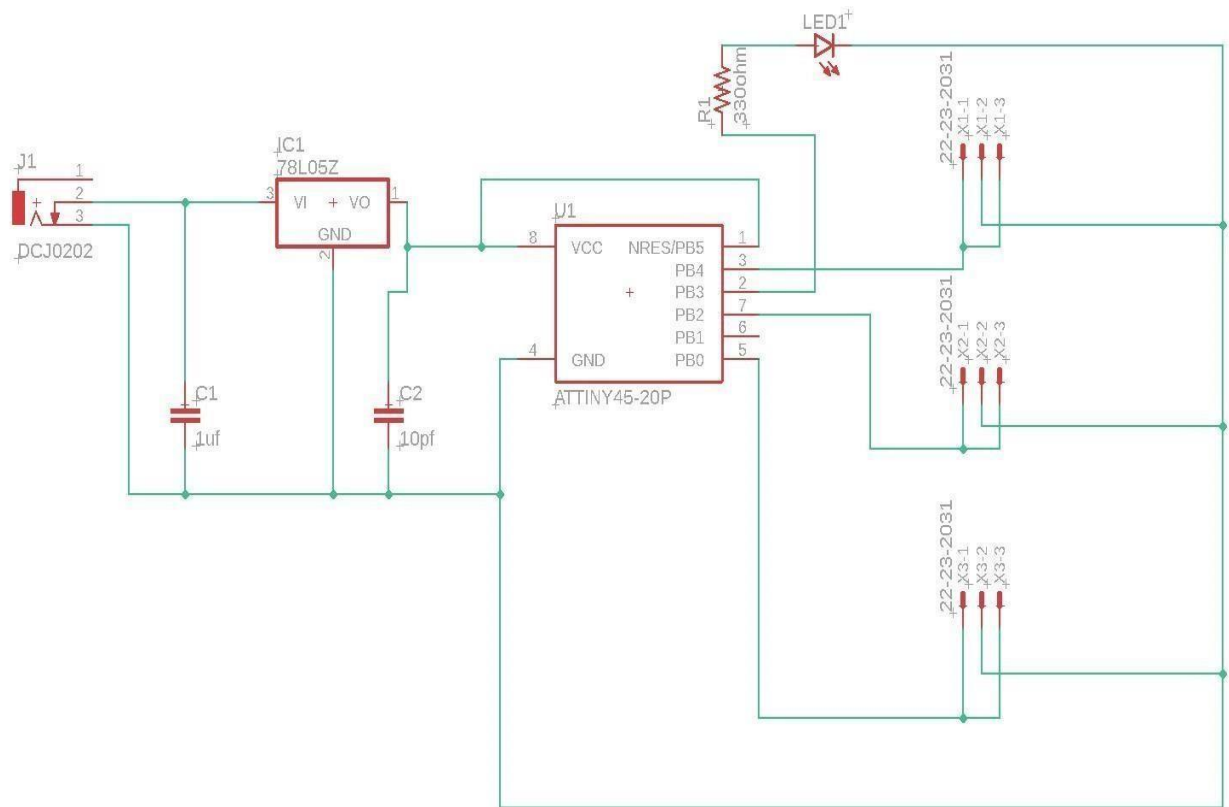


Fig. 1.7 Schematic diagram of Transmitter circuit

Printed Circuit Board layout:

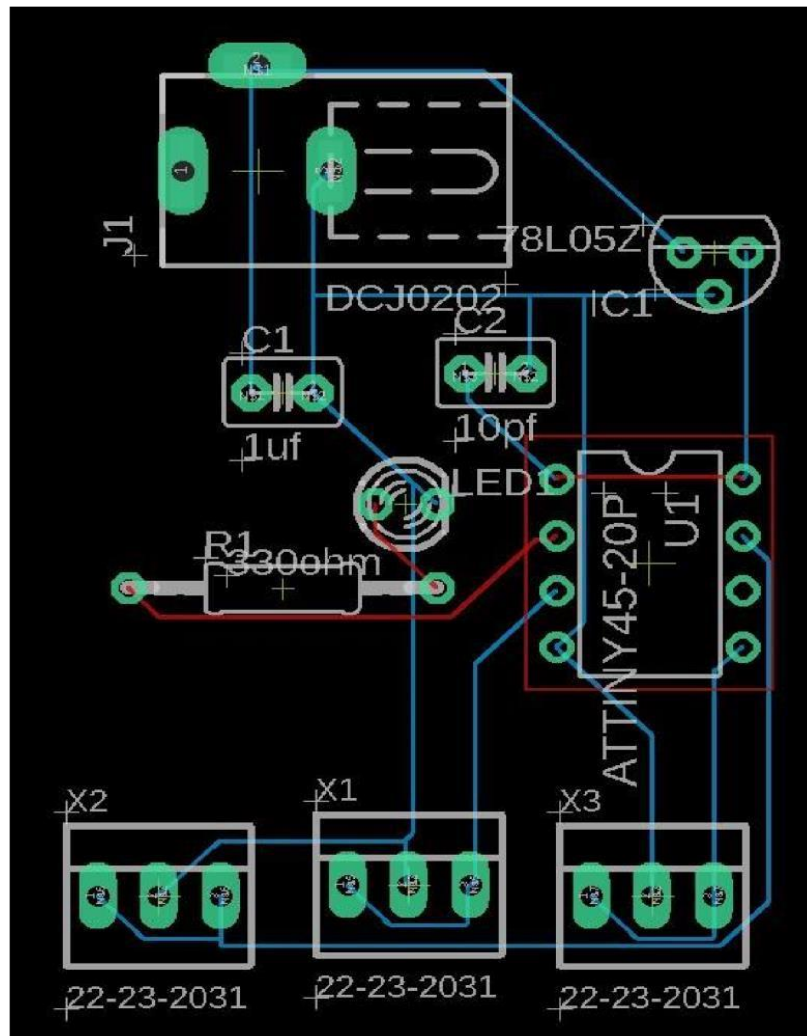


Fig. 1.8 PCB layout of Transmitter circuit

Objective:

1. To draw a schematic circuit diagram of PWM Receiver for Gantry using Autodesk Eagle software.
2. To design a Printed Circuit Board layout of PWM Receiver for Gantry Autodesk Eagle software
3. **Software Used:** Eagle Software

4. Component Used:

Sr. No	Name of Components	Value	Specifications
1.	Resistor	120K	Carbon Resistor with 5% Tolerance
2.	Resistor	100K Ω	Carbon Resistor with 5% Tolerance
3	Resistor	22 K Ω	Carbon Resistor with 5% Tolerance
4	Resistor	1 K Ω	Carbon Resistor with 5% Tolerance
5	Capacitor	100nF	Ceramic Capacitor
6	LM311D		Voltage Comparator
7	MBD701		Schottky diode
8	22-23-2031		PCB Header

Theory:

This circuit receives the signal and the voltage comparator analyses the signal to either carry forward the current or to cut the supply to the further circuit. The diode used is for faster operation of the circuit as this diode has fast switching speeds. We also use the use of PCB headers and how it helps connect different components on to one circuit board.

Components Used:

1. **Resistor:** A resistor is a 2-terminal electric component which is used to reduce the flow of current in an electric circuit. It is also used in Integrated Circuits and is used to avoid any damage to other low voltage components like a LED. The electrical function is defined by its magnitude of resistance and its units are in Ohm (Ω).



Fig. 2.1 Various types of resistors

2. **Capacitor:** The capacitor is a component which that stores electrical energy in an electric field. It is a passive electronic component with two terminals. A capacitor consists of two conductors separated by a non-conductive region. The effect of a capacitor is known as [capacitance](#).

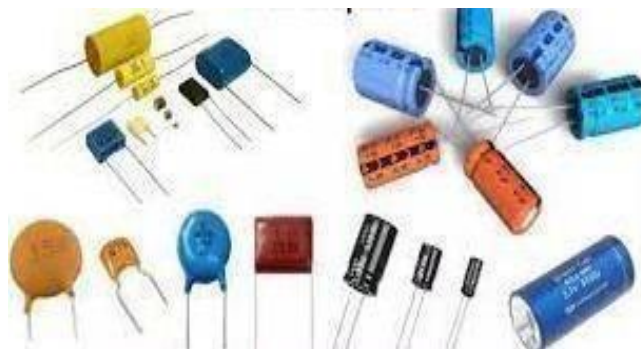


Fig. 2.2 Various types of capacitors

3. Voltage Comparator: This device compares the values of the input voltages and gives the output as which is bigger in magnitude. It has two analog input terminals V_+ and V_- and one binary digital output V_o . The most common used comparator is a high-gain differential amplifier. The outputs can be opendrain output or push-pull output. We get the outputs near to the supply voltage which in our case is +5V.

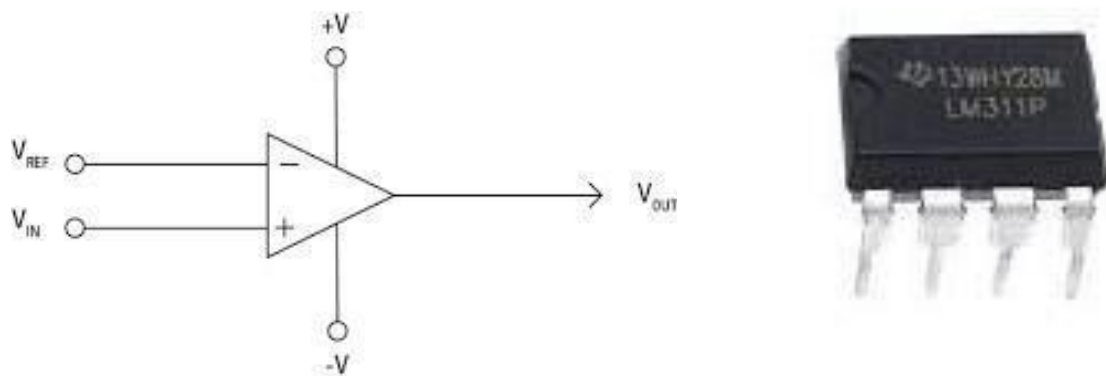


Fig. 2.3 Voltage Comparator

4. Schottky Diode: This diode has very high switching speeds due to its low forward voltage requirement. It is actually a semiconductor diode and compared to a silicon diode, it has very low voltage drop so it is more efficient. This diode is used as a rectifier as it has very less power loss.

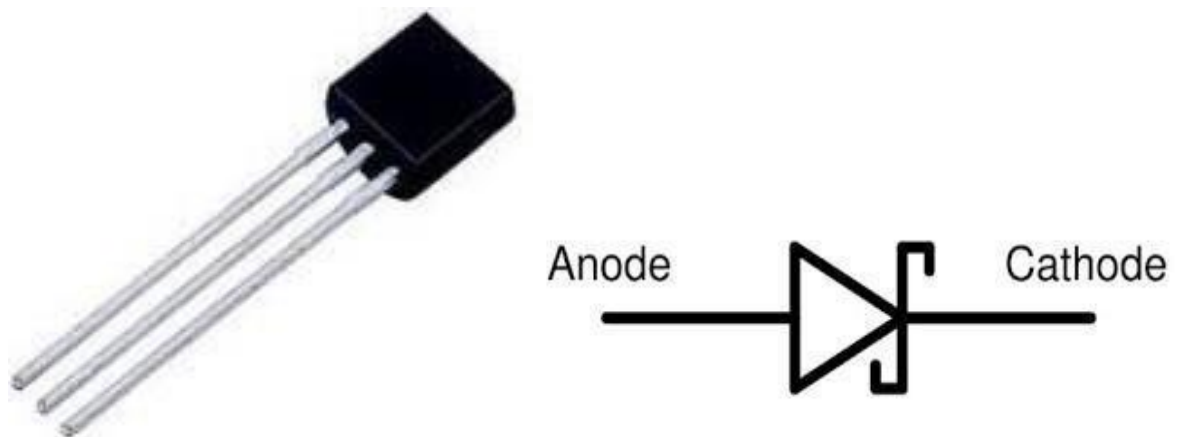


Fig. 2.4 Schottky Diode

7. **22-23-2031**: 22-23-2031 is a 2.54 mm pitch wire to board connectors. It incorporates offset header entry holes that provide +180°C polarization and allows both power and signal to carry through the same housing. This connector system also allows loading with optional polarization keys and pegs that ensures one way mating of headers and housings.



Fig. 2.5 PCB header

8. PCB Board: Printed circuit boards (PCBs) are the foundational building block of most modern electronic devices. Whether simple single layered boards used in your garage door opener, to the six layer board in your smart watch, to a 60 layer, very high density and high-speed circuit boards used in super computers and servers, printed circuit boards are the foundation on which all of the other electronic components are assembled onto.



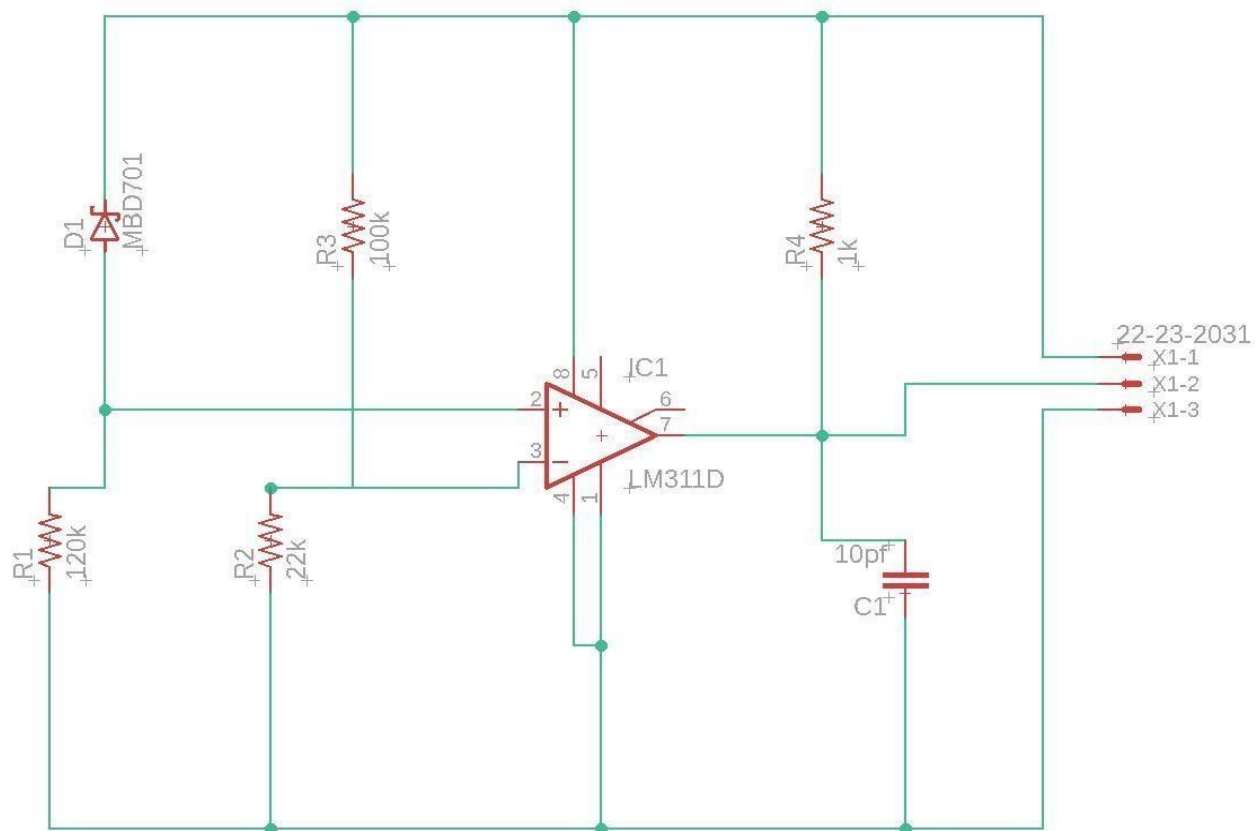
Fig. 1.8 PCB Board

9. Soldering Station: A soldering station is a multipurpose power soldering device designed for electronic components soldering. This type of equipment is mostly used in electronics and electrical engineering. Soldering station consists of one or more soldering tools connected to the main unit, which includes the controls (temperature adjustment), means of indication, and may be equipped with an electric transformer. Soldering stations may

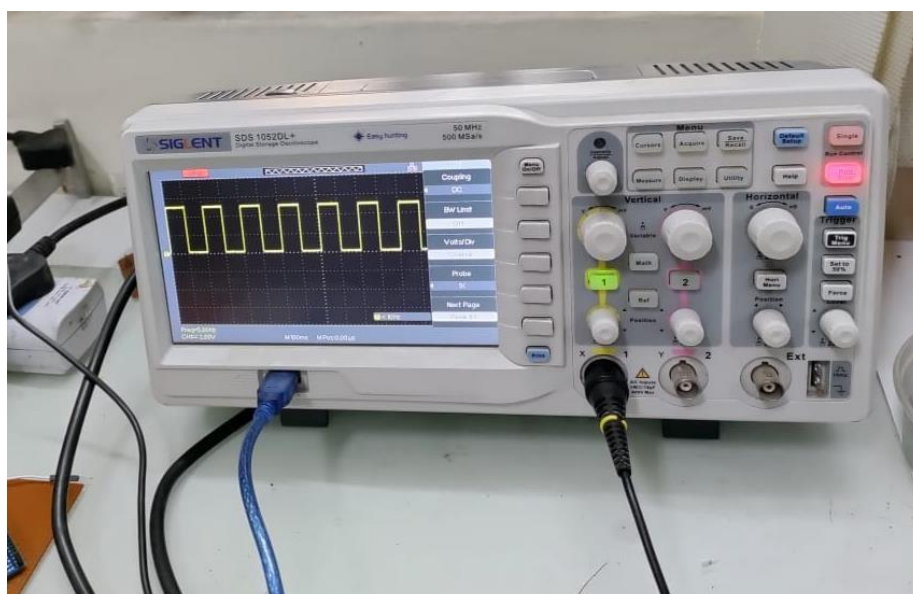
include some accessories – holders and stands, soldering tip cleaners, etc. Soldering stations are widely used in electronics repair workshops, electronic laboratories, in industry.



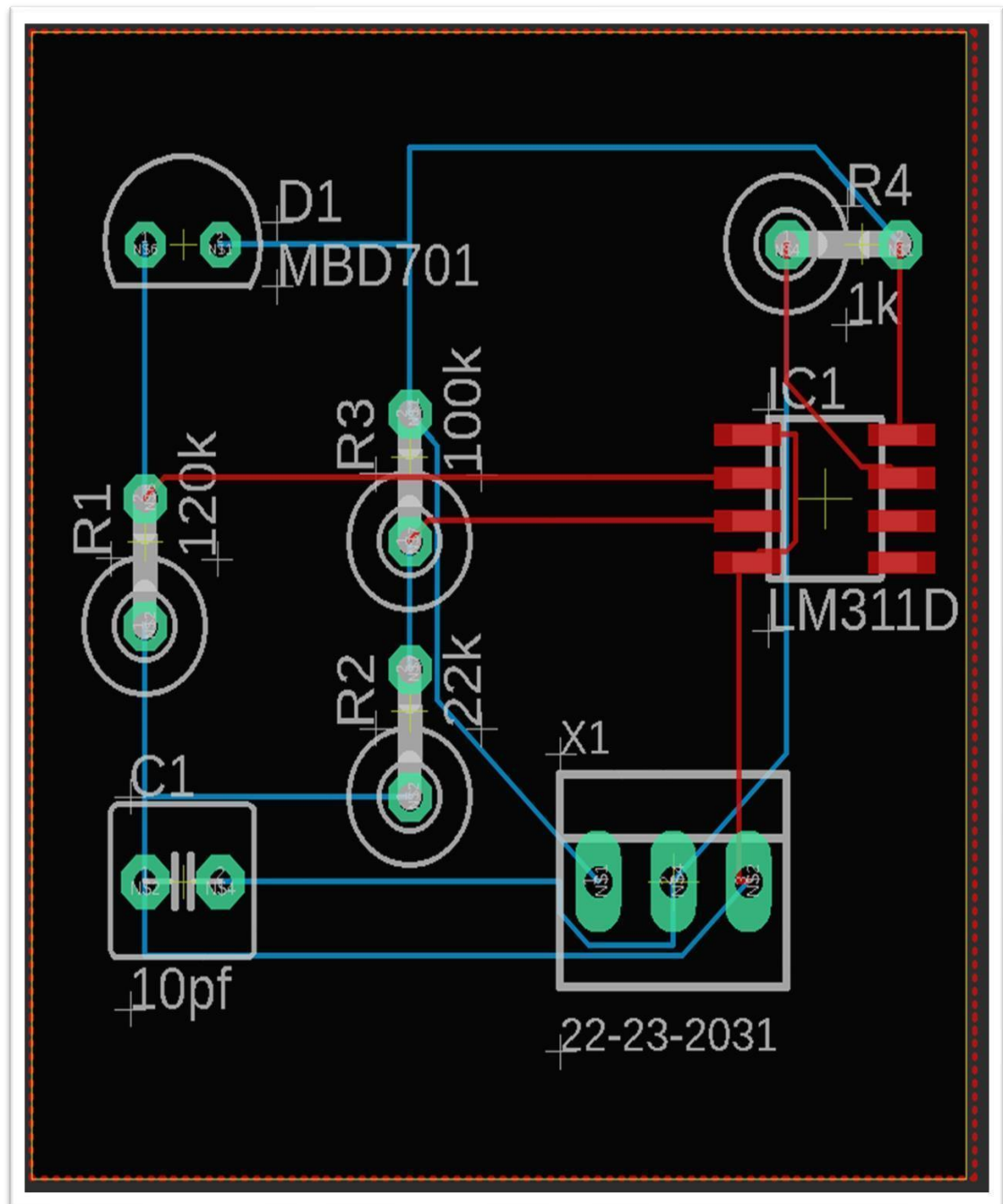
Schematic diagram:



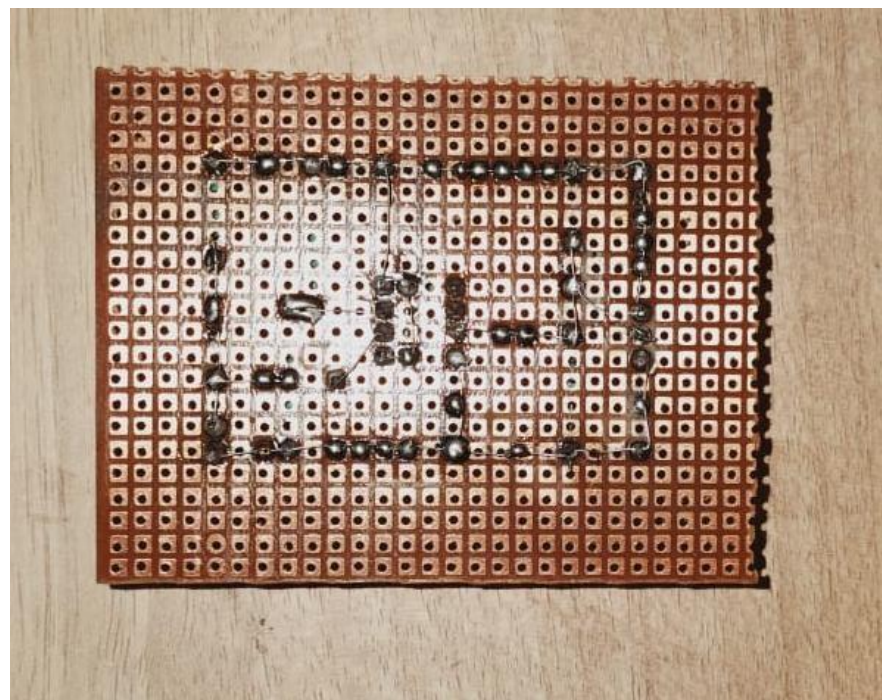
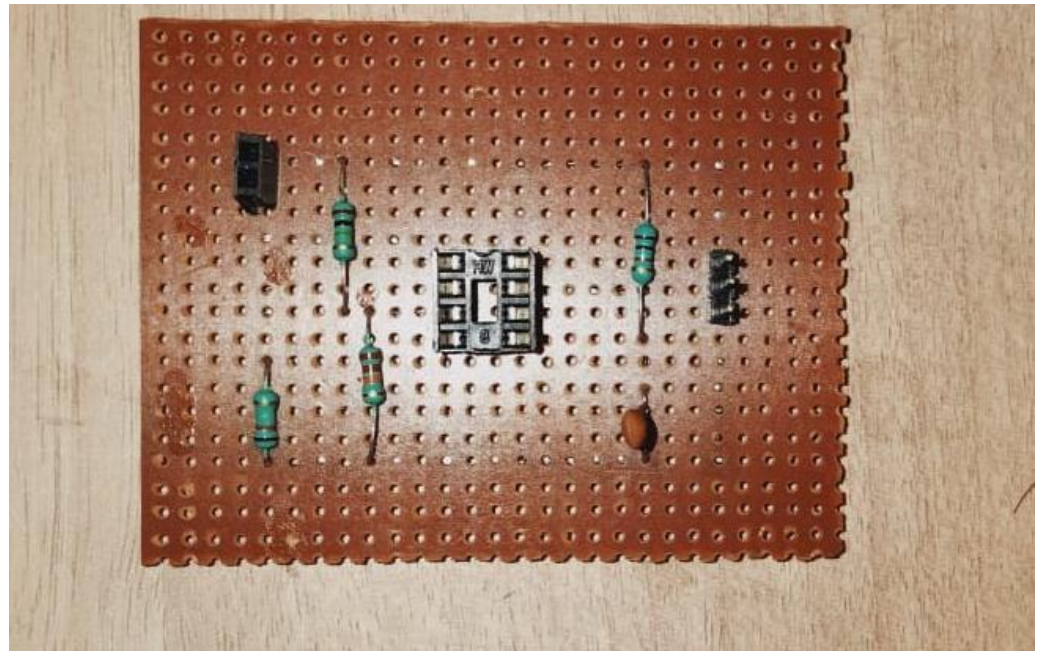
Waveform:



Printed Circuit Board layout:



Circuit:



Objective:

1. To draw a schematic diagram of IR sensor module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Autodesk Eagle software.
2. To design a printed circuit board layout of IR sensor module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Autodesk Eagle software.\

3. **Software Used:** Eagle Software

4. **Component Used:**

Sr. No	Name of Components	Value	Specifications
1.	Resistor	10K ohm	Carbon Resistor with 5% Tolerance
2.	Resistor	330K ohm	Carbon Resistor with 5% Tolerance
3.	LMV358MM		Operational Amplifier
4.	BPX65		Photodiode
5.	SFH482		Photodiode
6.	Potentiometer		3-terminal resistor
7.	MTA02-100		AMP Connector
8.	LED		A two-lead semiconductor light source

Theory:

IR sensor is **an electronic device**, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

Components Used:

1. Resistor: A resistor is a 2-terminal electric component which is used to reduce the flow of current in an electric circuit. It is also used in Integrated Circuits and is used to avoid any damage to other low voltage components like a LED. The electrical function is defined by its magnitude of resistance and its units are in Ohm (Ω).

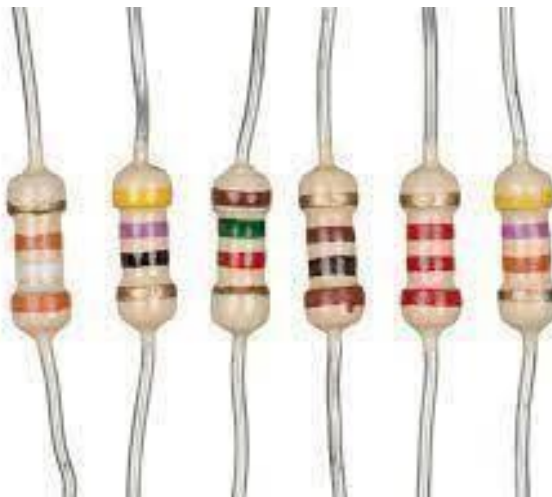


Fig. 3.1 Various types of resistors

2. LMV358MM: LMV358 is a single or dual low-voltage op amp with rail-to-rail output swing. This device is a cost-effective solution for applications where low-voltage operation, space-saving, and low cost are needed. This amplifier is designed specifically for low-voltage (2.7 V to 5 V) operation. It exhibits excellent speed to power ratio, achieving 1MHz of bandwidth and 1V/ μ s slew rate with low supply current. It also allows the designer to place the device closer to the signal source to reduce noise pickup and increase signal integrity.



Fig. 3.2 LMV358MM

3. BPX65: The BPX65 is a 3-pin 1mm² High Speed Detector features high sensitivity. It has been used for encoder designs and with MIL SPEC release at the heart of advanced laser warning systems. 5nA Maximum dark current. A device that converts light into an electrical current. The current is generated when photons are absorbed in the photodiode. They may contain optical filters, built-in lenses, and may have large or small surface areas.



Fig. 3.3 BPX65

4. SFH482: It is used as a transmitter to make the schematic circuit complete in the IR receiver circuit. It is small wired transmitter for repeating an infrared signal from your remote to an isolated piece of A/V equipment.



Fig. 3.4 SFH482

5. Potentiometer: It is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Linear potentiometers linearly measure displacement and rotary potentiometers measure rotational displacement.



Fig. 3.5 Potentiometer

6. MTA02-100: The MTA connector system is a wire-to-board and wire-to-wire system based on insulation displacement contact (IDC) technology. The MTA-100 interconnection system is used for wire-to-board or wire-to-wire applications using insulation displacement contacts, or IDCs. The MTA-100 IDC connector system is a wire-to-board and wire-to-wire system with contacts in a single row on 0.100" (2.54 mm) centreline.



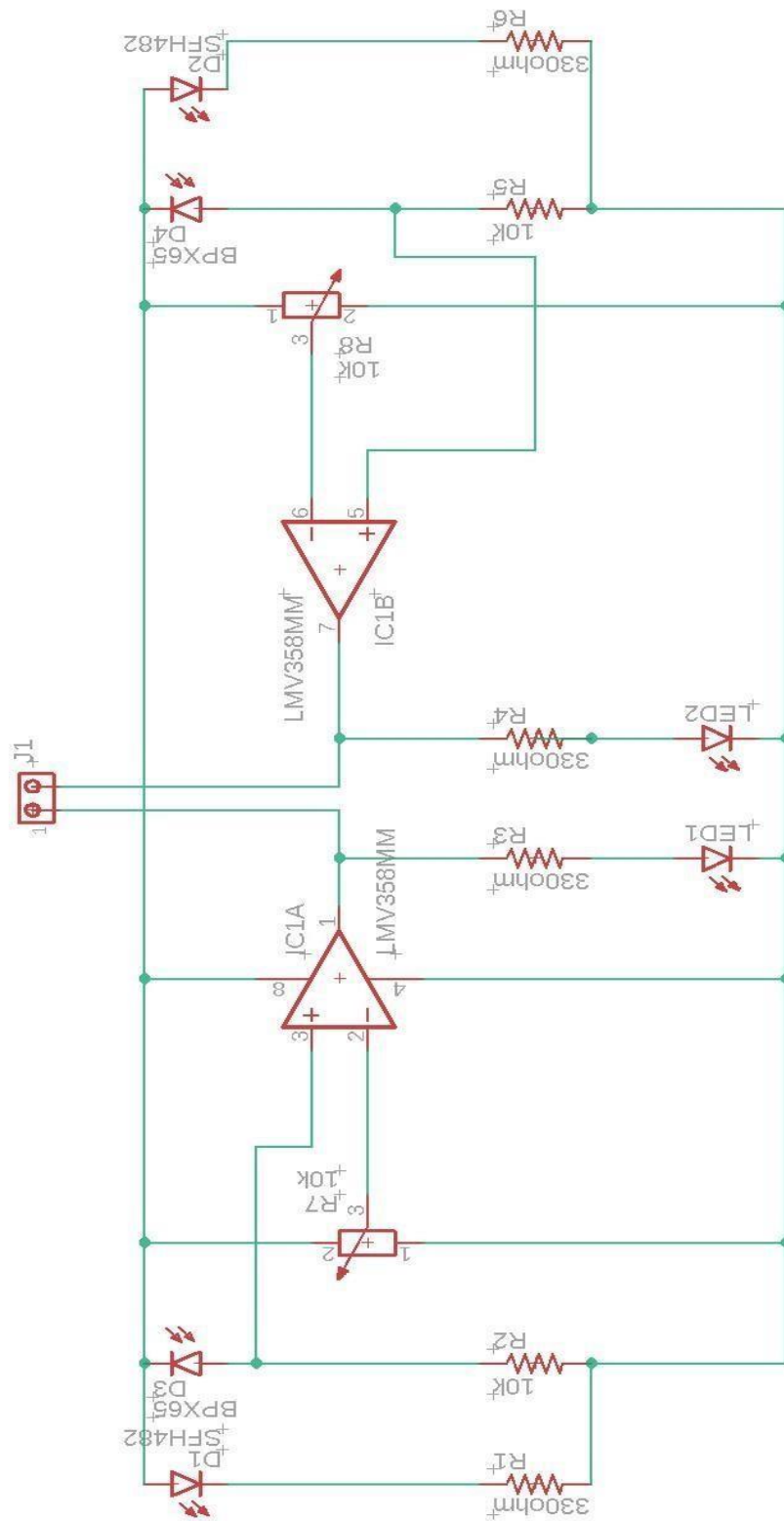
Fig. 3.6 MTA02-100

7. LED: (LED) is a semiconductor light source that emits light when current flows through it. LED, in full light-emitting diode, in electronics, a semiconductor device that emits infrared or visible light when charged with an electric current. Visible LEDs are used in many electronic devices as indicator lamps, in automobiles as rear-window and brake lights, and on billboards and signs as alphanumeric displays or even full-colour posters. Infrared LEDs are employed in autofocus cameras and television remote controls and also as light sources in fibreoptic telecommunication systems.

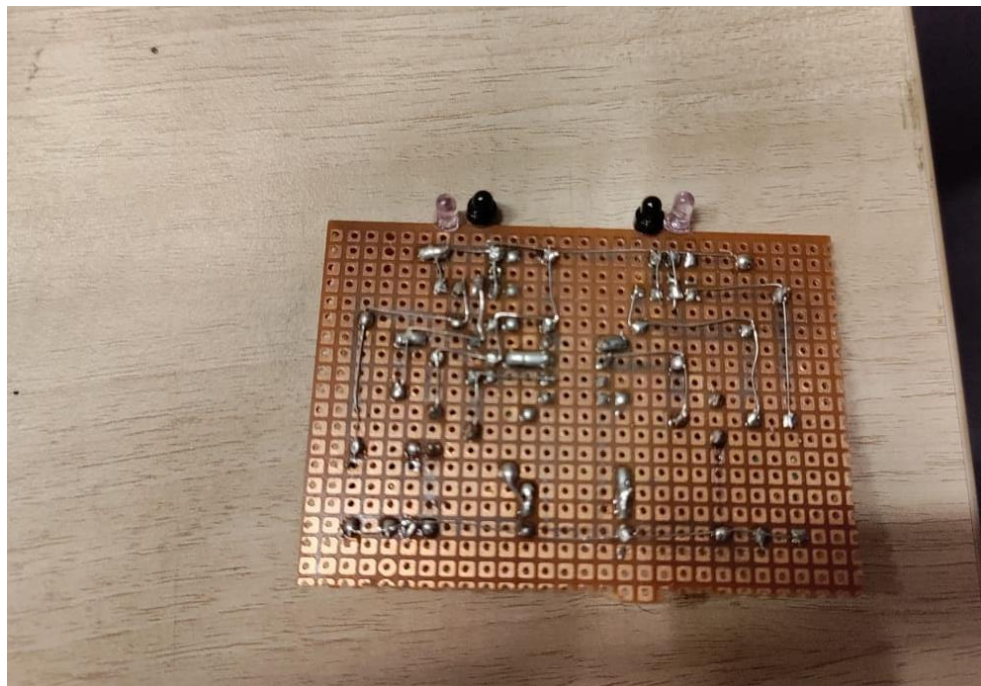
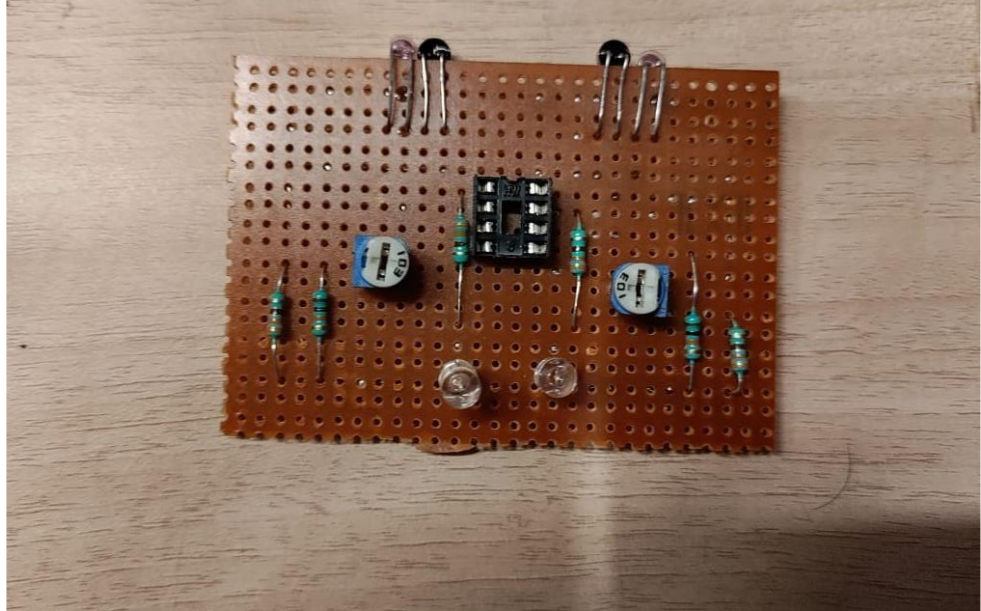


Fig. 3.7 LED

Schematic diagram:



Circuit:



Printed Circuit Board layout:

