# WORK PLAN AND METHODOLOGY

**1. Powering the Circuit:**

First, we need to power the circuit. The circuit is designed to operate on 5 Volts DC (Direct-Current) Supply. We can power the circuit by two ways,

1. **Battery:** If we power the circuit using 9V battery, we need an extra component LM7805 IC which is used to step down the voltage to 5V. As the result of differential voltage, heat is released in IC. So, we require TO220 (Package) Heat Sink to protect the IC from damage.
2. **Direct Supply:** We can power the circuit using old mobile phone chargers which has DC Output of 5V.

**2. Setting of IR LED:**

IR LED should always be ON and it should not be connected directly to the 5V supply. IR LED will consume 20 mA of current at 3V. So, we need to attach a current limiting Resistor to this branch. Calculation of Resistance,

$$\mathbf{R_{IR}} = \frac{\mathbf{5-3}}{\mathbf{20x10^{-3}}} = 100 \text{ ohms}$$

**3. Setting of Photodiode:**

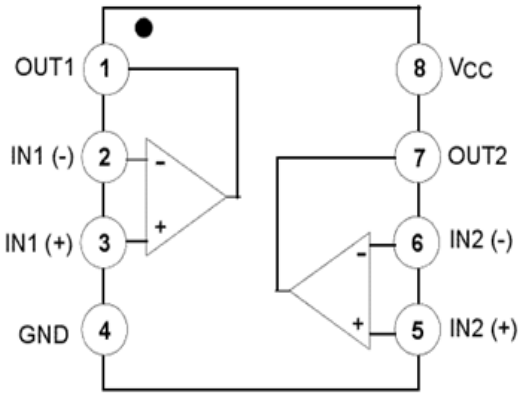
Photodiode can be called as Infrared Ray Dependent Resistor. As the intensity of Infrared rays falls on it increases the resistance gets decreased. This in series connected to a 10k ohm resistor forms a voltage divider circuit and the connection point is tapped and connected to non-inverting terminal of Op-Amp.

**4. Setting of Potentiometer:**

Potentiometer is used adjust the sensitivity (range) of the sensor. That is, when the Potentiometer is rotated, voltage at the centre terminal changes. Here we choose 10k POT and the centre terminal of the Potentiometer is connected to inverting terminal of Op-Amp.

**5. Operation of Op-Amp:**

**PIN DIAGRAM (LM358 IC):**




We are using LM358 IC which as two Op-Amps in it. But we are just going to use one of them. It is normally used to do Mathematical Operations and Amplify the input signals. But we are using this Op-Amp as a Voltage Comparator for the circuit. The voltage comparator will compare two inputs and gives the output as either HIGH or LOW. The IC is powered by direct 5V from the supply ($V_{CC}$-8) and it is grounded (GND-4). The non-inverting input ($IN1^+$-3) is connected to the Photodiode. The inverting input ($IN1^-$-2) is connected to the Potentiometer. If the voltage at the Non-Inverting terminal of the Op-Amp is HIGH then the Output will be HIGH else LOW. As LM358 IC is non-rail to rail IC means, The Voltage of the Output (OUT1-1) will not be the exact voltage as the $V_{CC}$, there is difference of 1V. So, if the Output is HIGH the voltage at the output terminal will 5V – 1V = 4V.

**6. Setting of Indicator LED:**

When the obstacle (hand) is detected, the device should show the output for the confirmation. So, the RED Diffused LED is used in this case. When the output is HIGH, the voltage at the output terminal will be 4V. But RED Diffused LED consumes 20 mA of current at 3V. We need to add a current limiting Resistor to it. Calculation of Resistance,

$$\mathbf{R_{IND}} = \frac{\mathbf{4-3}}{\mathbf{20x10^{-3}}} = 50 \text{ ohms}$$

So, we choose a higher value of resistor 68 ohms since it is available in the market easily.

**7. Switching Circuit:**

For switching the Relay ON we require 5V, it consumes 70 mA of current. Now, we cannot directly power the Relay from the output of the Op-Amp. So, we are using an electronic switch – Transistor in common emitter configuration as a switch. We are using NPN 2N2222A Transistor since we are using it to

ground the Relay. The Emitter of the Transistor is grounded, the collector terminal is connected to one end of the Relay as the other end is connected to direct 5V supply. As we increase is the base current, collector current increases. As base current is very small, it should not be connected directly to output terminal of the Op-Amp. So, we connect a base resistor to limit the flow of current to the base. Calculation of base resistor,

$I_B = \frac{I_C}{\beta} = \frac{70x10^{-3}}{10} = 7$ mA $\qquad$ $R_b = \frac{\mathbf{4-0.7}}{\mathbf{7x10^{-3}}} = 471.42$ ohms

We choose the nearest value of 500 ohms. We connect two 1k ohm resistors in parallel to get 500 ohms.

**8. Setting of Relay:**

The two coil terminals of the Relay are connected to the direct 5V supply and collector terminal of the transistor. Common Terminal and N-O (Normally-Opened) Terminal of the Relay is connected or Integrated with the Bell Switch. In this way, we can either remove the old bell switch or we can just use both.