

TOUCHLESS SWITCH

INNOVATIVE WORK IN ELECTRONIC
DEVICES AND CIRCUITS, EE-203, 3rd
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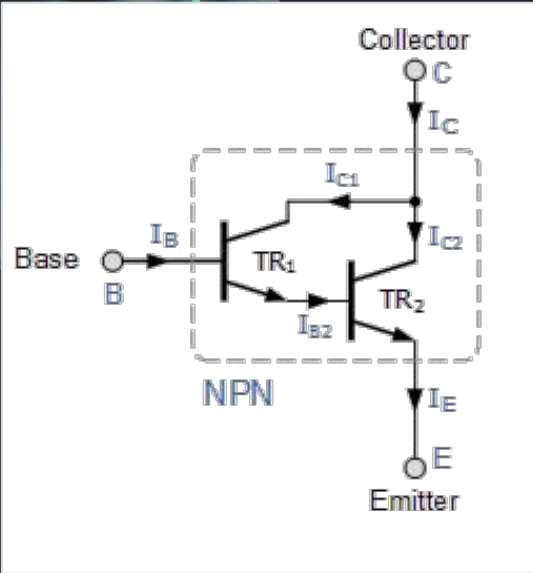
Aim

The aim of this project is to design a hardware circuit prototype for a touchless switch without using expensive components like IR sensors.

The design process will first be carried out on SPICE simulation softwares and then the final circuit will be tested on a breadboard.

After getting successful results, the final circuit will be soldered on a copper laminated circuit board.

Darlington Pair



The Darlington Transistor configuration of two bipolar transistors offers increased current gain for a given base current

The Emitter of one transistor is connected to the Base of the other to produce a more sensitive transistor with a much larger current gain being useful in applications where current amplification is required.

$$I_C = I_{C1} + I_{C2}$$

$$I_C = \beta_1 \cdot I_B + \beta_2 \cdot I_{B2}$$

$$I_C = (\beta_1 + (\beta_2 \cdot \beta_1) + \beta_2) \cdot I_B$$

Transistor BC 547

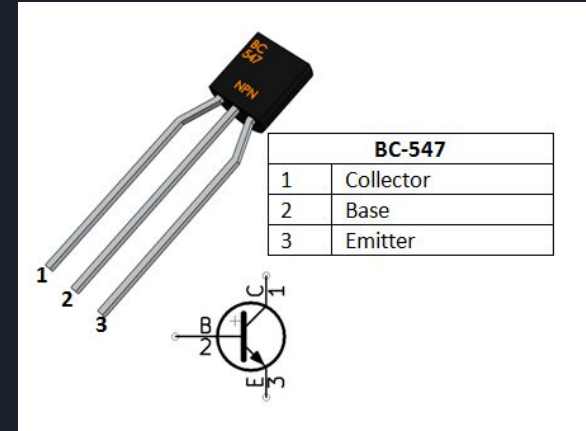
BC547 Transistor Features

- Bi-Polar NPN Transistor
- DC Current Gain (h_{FE}) is 800 maximum
- Continuous Collector current (I_C) is 100mA
- Emitter Base Voltage (V_{BE}) is 6V
- Base Current(I_B) is 5mA maximum

common emitter type is the popular and mostly used configuration. When uses as an Amplifier the DC current gain of the Transistor can be calculated by using the below formulae $DC \text{ Current Gain} = \text{Collector Current } (I_C) / \text{Base Current } (I_B)$

Applications

- Amplifier modules like Audio amplifiers, signal Amplifier etc..
- Darlington pair



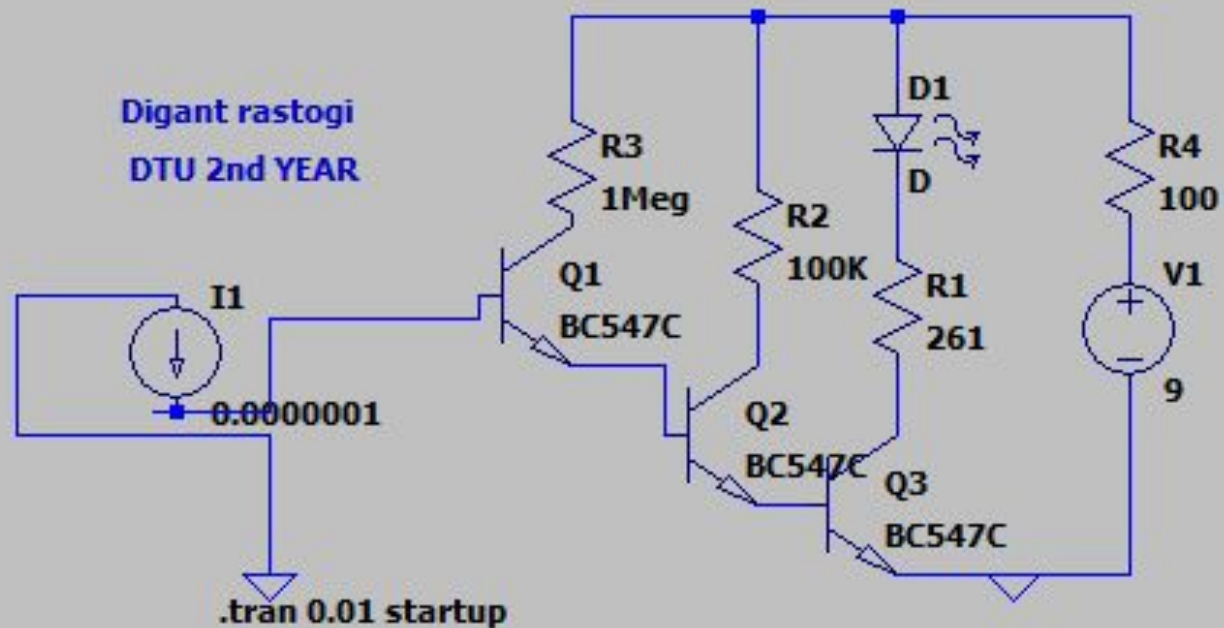


Project and Methodology

Human hands have slight electrostatic charges accumulated. These charges can be used to detect the human hand. By using a darlington pair transistor, we can detect the very small current on our body by amplifying it to a sufficiently high value. To make an appropriate circuit, LTSpice simulations were used. It was found that after using a pair of transistors in darlington formatio, current was not enough. And by using two darlington pairs cascaded, the current was too much for the purpose of this project. Hence after experimentation, 3 cascaded transistors were used

After sufficient testing using LTSpice, the model was created on Breadboard and then finally on a copper board.

Circuit





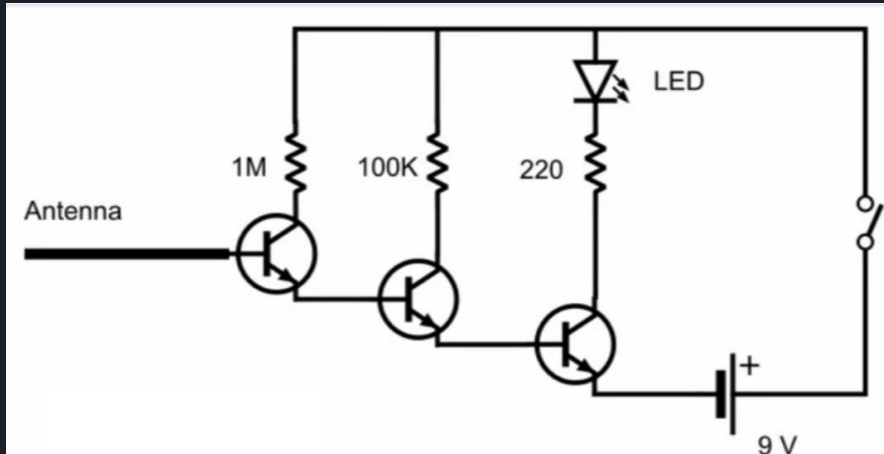
Circuit components and price

The components were procured from a wholesale seller of electronic components in Lala Lajpat Rai Market situated in Chandni Chowk, Old Delhi. The prices are as follows. The total cost of all components was Rs 40.

<u>COMPONENT</u>	<u>PRICE</u>
BC 547NPN BJT TRANSISTOR 1 PC	2 RS/PC
1M, 100K, 220 OHM RESISTOR	1 RS/4 PC
RED LED	RS 4/PC
INSULATED COPPER WIRE	RS 5/ METER
BREADBOARD, COPPER BOARD	RS 75/PC, 7/PC
9V BATTERY	RS 20/PC

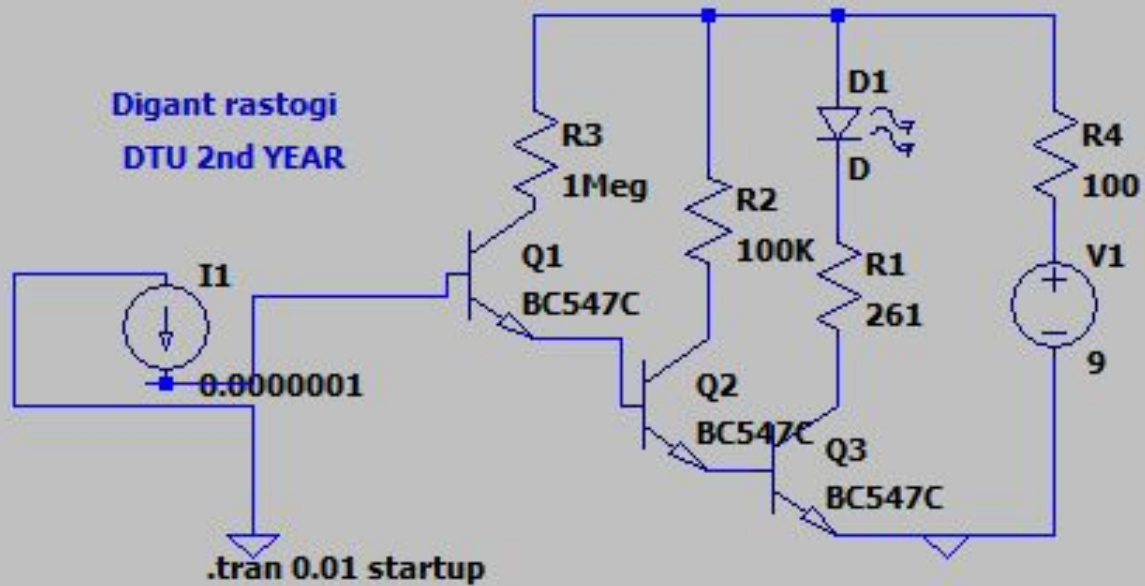
Working

The antenna develops a current due to induction because of the electrostatic charges present on a human hand. This current as small as a few nano amperes. The first transistor of the darlington amplifies this current, by $\beta=55$. The amplified current is again amplified by the two transistors by the order of 40000. The net current gain is around 2,00,000.



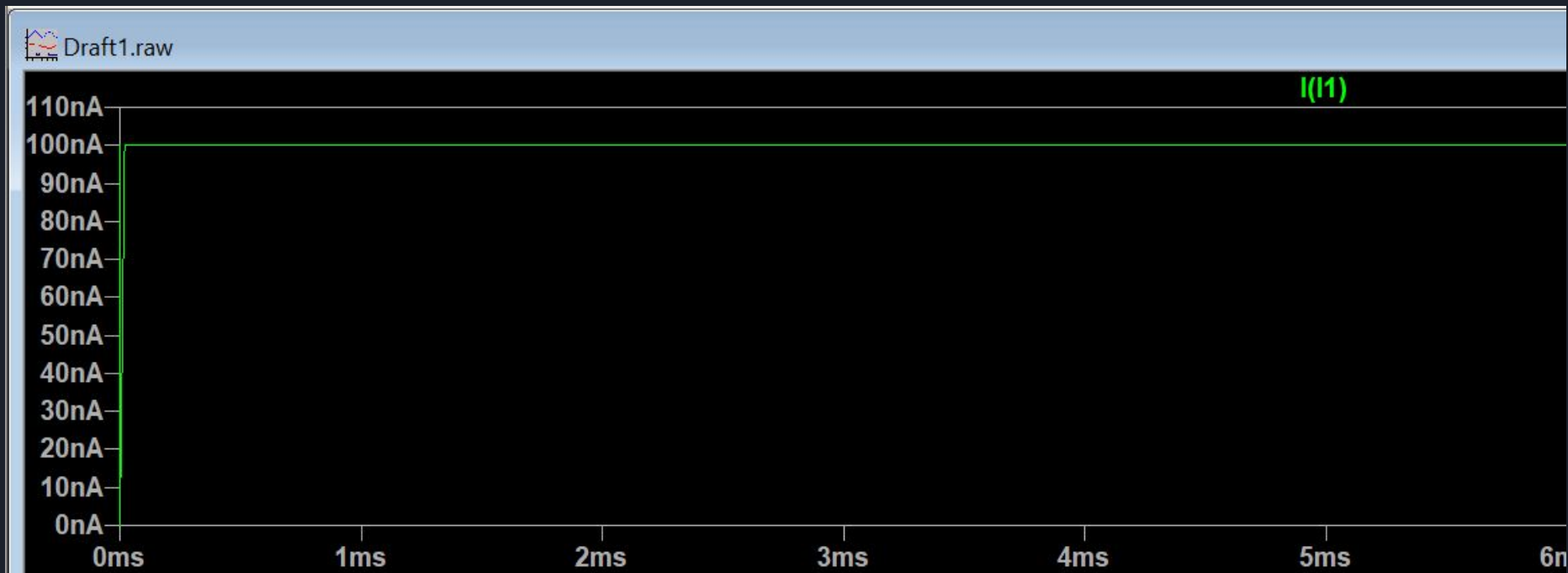
Circuit diagram made using
<https://www.circuit-diagram.org/>

Simulation

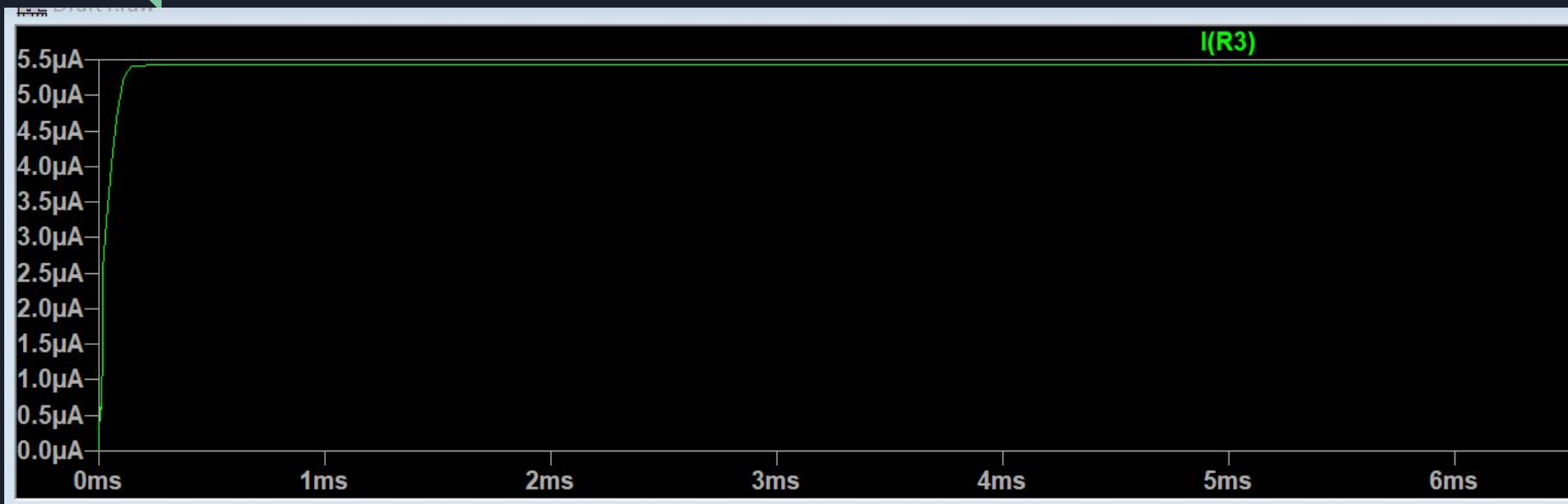


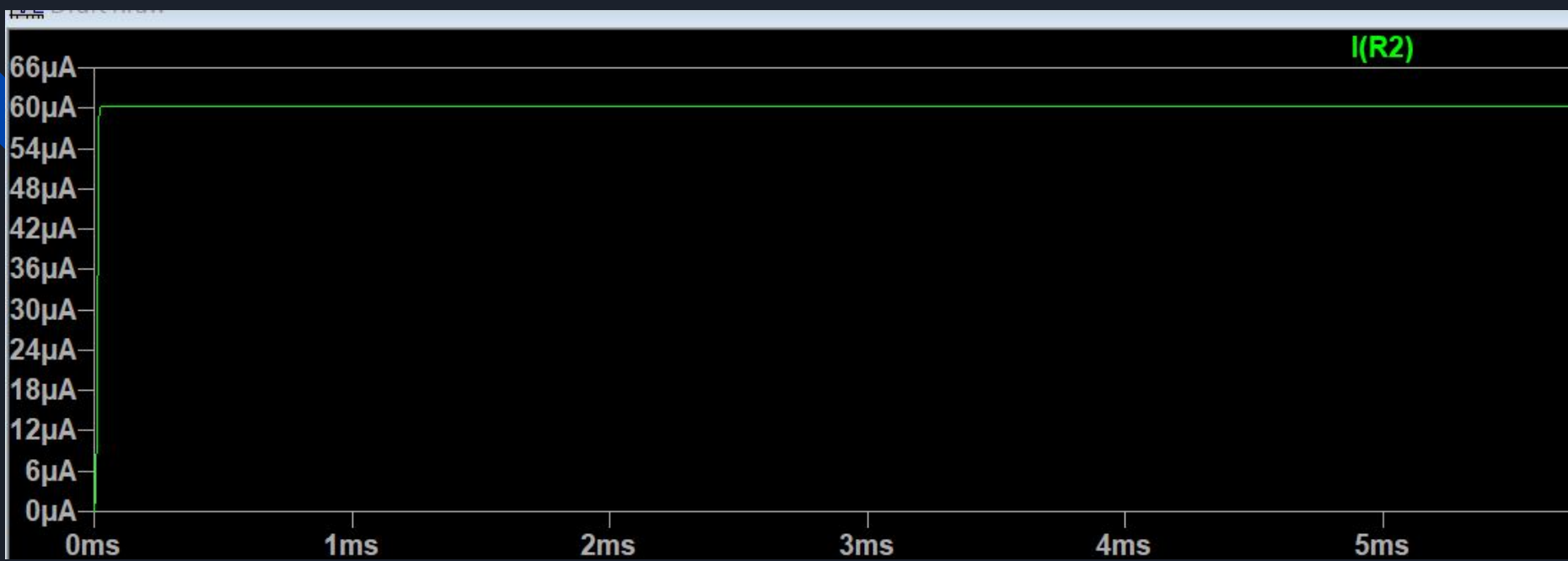
Results

INPUT CURRENT

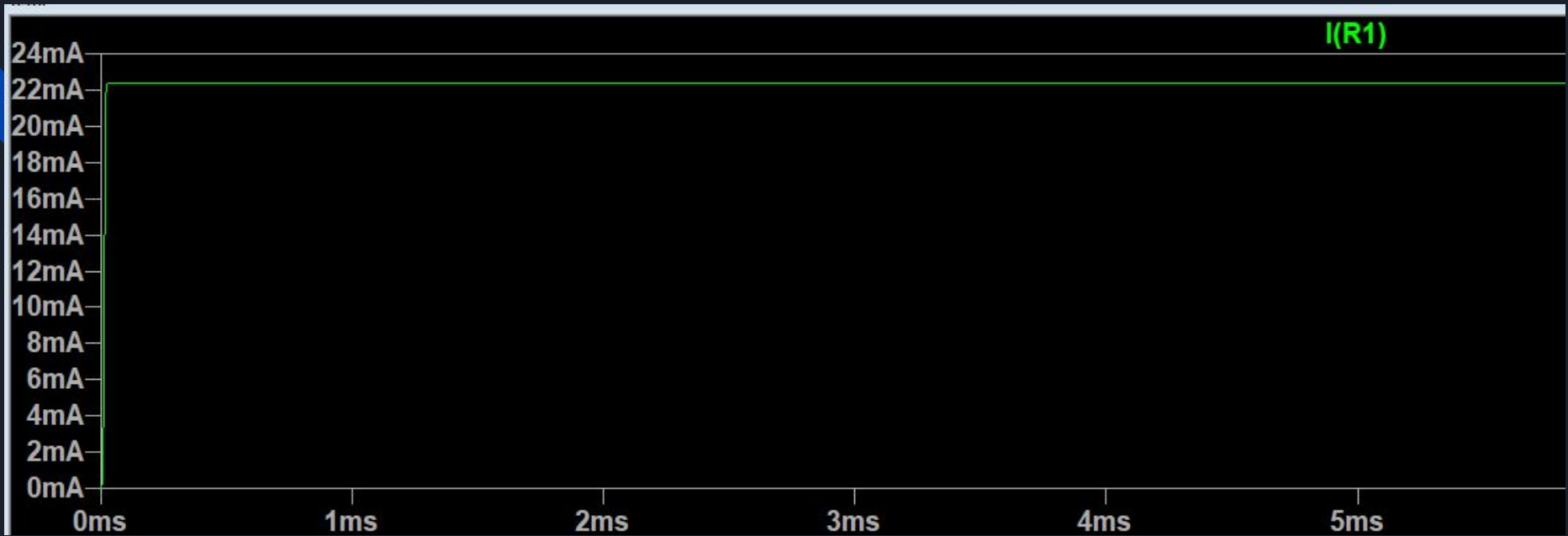


COLLECTOR CURRENT OF TRANSISTOR 1



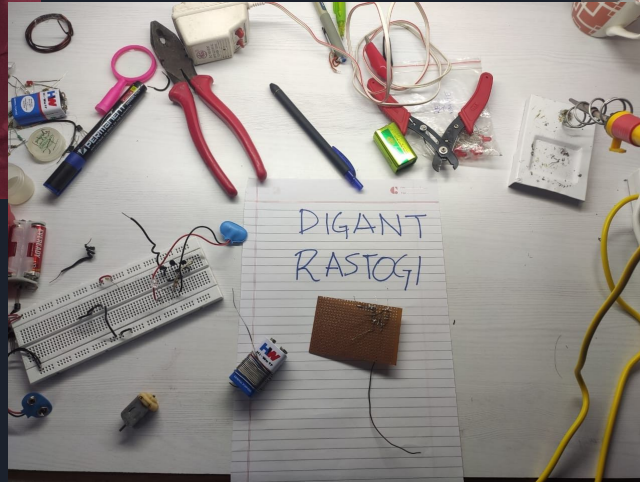


COLLECTOR CURRENT FOR
TRANSISTOR 2

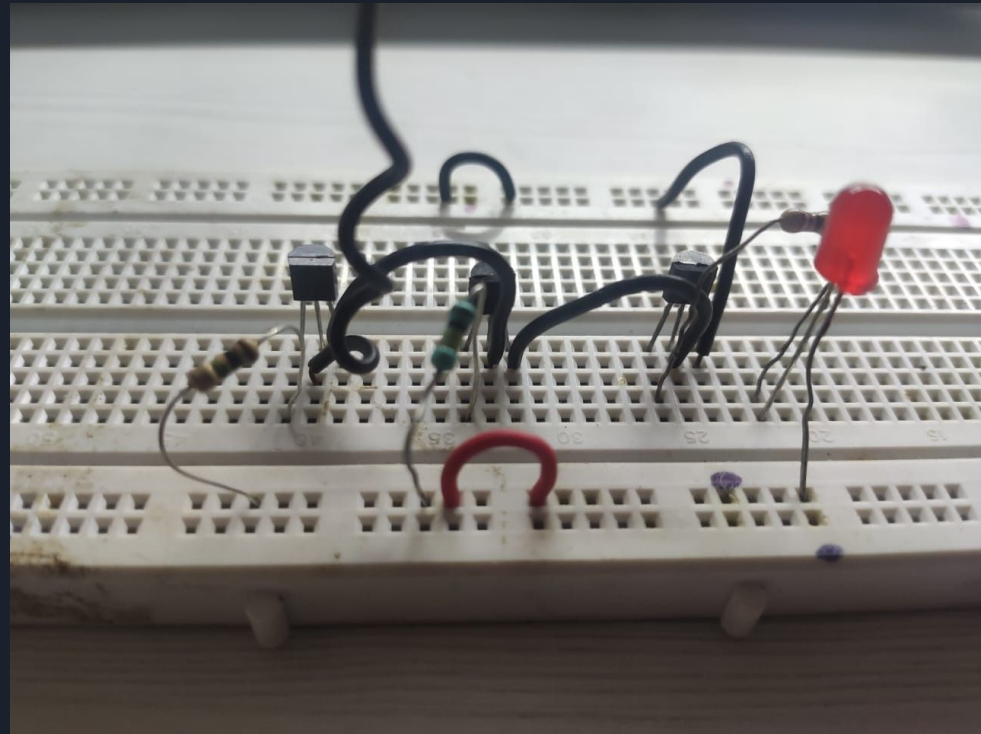
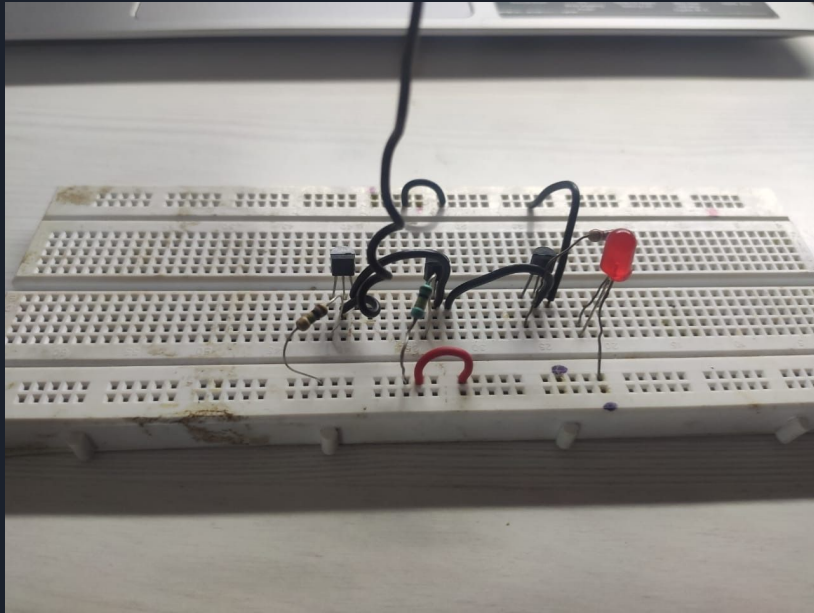


COLLECTOR CURRENT FOR
TRANSISTOR 3

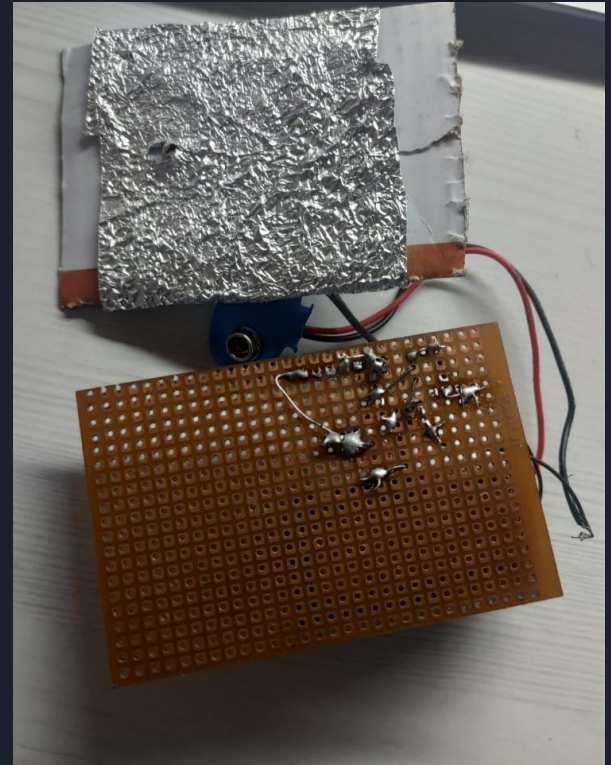
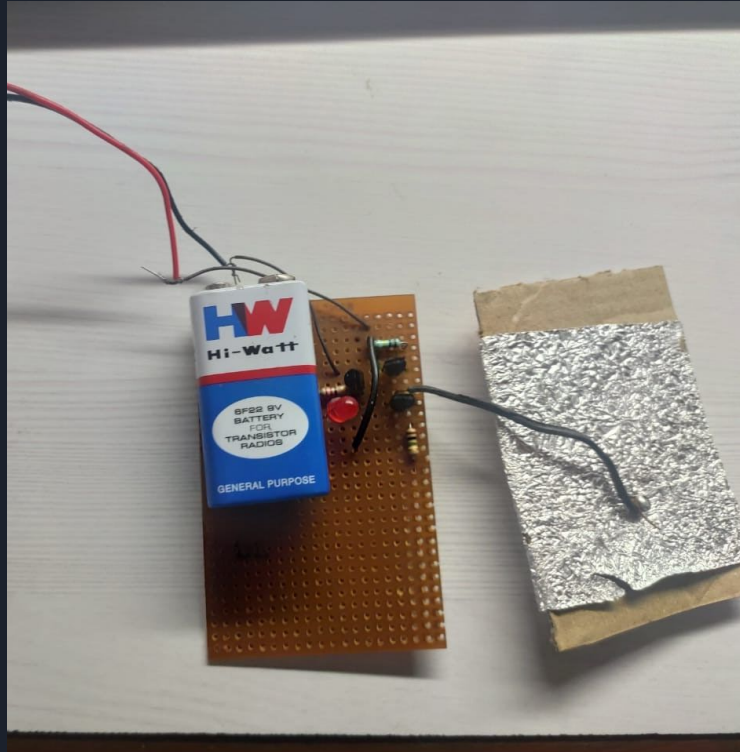
PICTURES



BREADBOARD TEST CIRCUIT

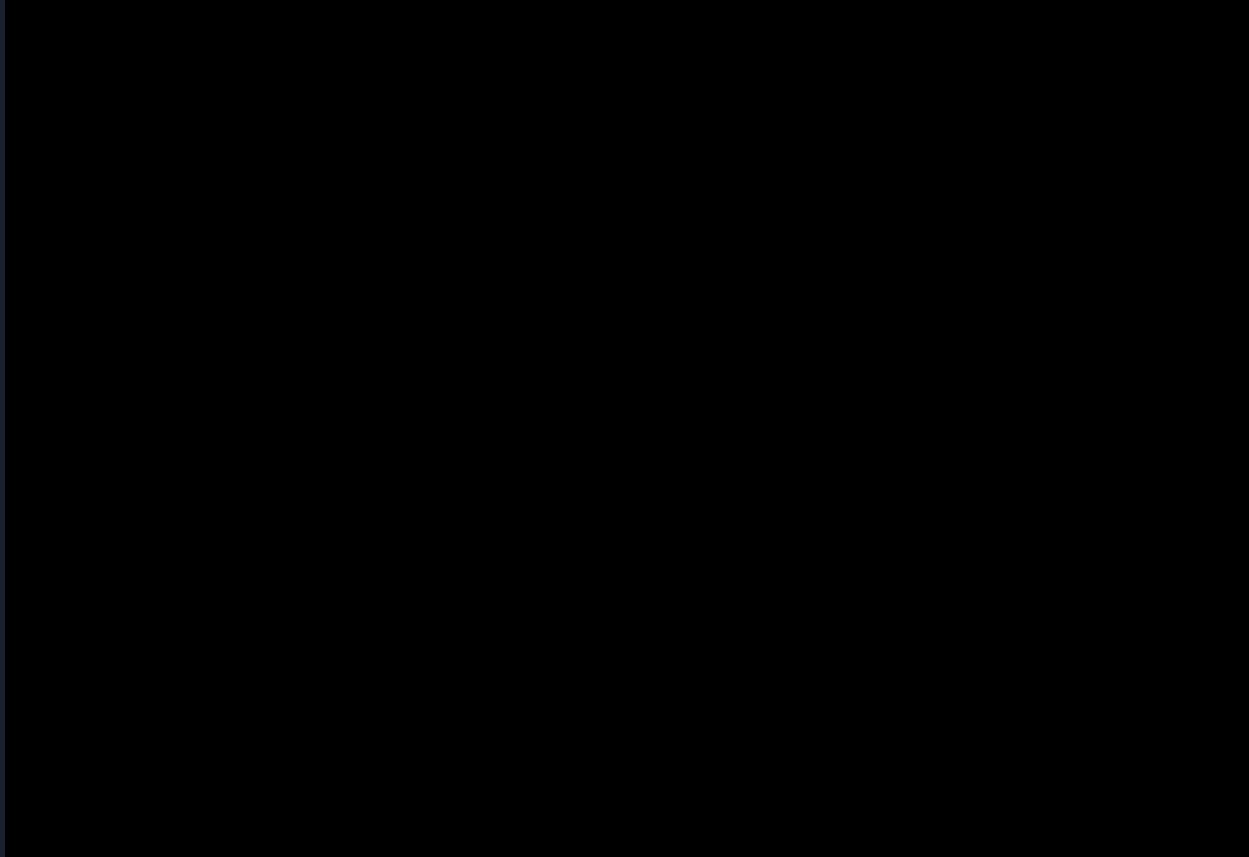


PCB CIRCUIT





VIDEO OF WORKING





APPLICATIONS AND ADVANTAGES

1. TOUCHLESS SWITCH: CURRENT PANDEMIC HAS REQUIRED US TO AVOID SURFACES THAT ARE FREQUENTLY TOUCHED. THIS NEW WAY, WE CAN COMPLETELY AVOID TOUCHING SWITCHES ETC.
2. PRICE: CURRENT SENSORS USE IR SENSOR TECHNOLOGY, WHICH ALONE COSTS UPWARDS OF RS 50. THIS WHOLE CIRCUIT COSTED AROUND RS 40.
3. DETECTOR: ELECTROSTATIC CHARGE BUILD UP NEAR SENSITIVE COMPONENTS CAN BE DETECTED
4. TO CHECK IF CAPACITOR IS CHARGED WITHOUT USING ITS TERMINALS
5. CIRCUIT CAN BE TUNED TO SENSE HEAT.



THANK YOU

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