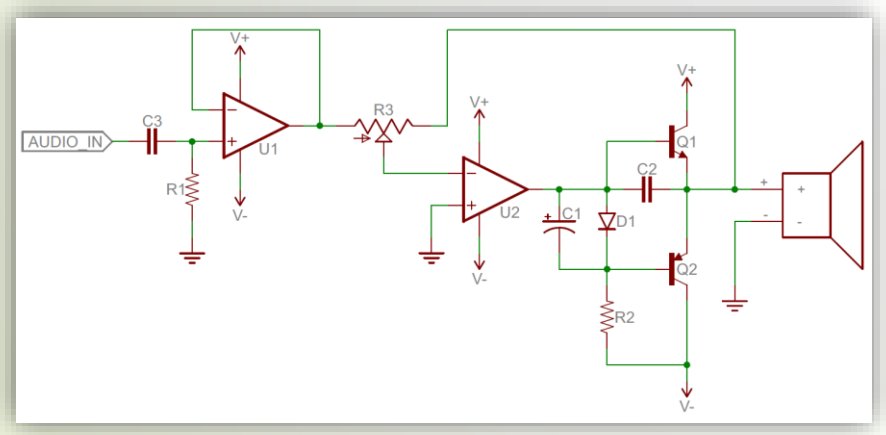
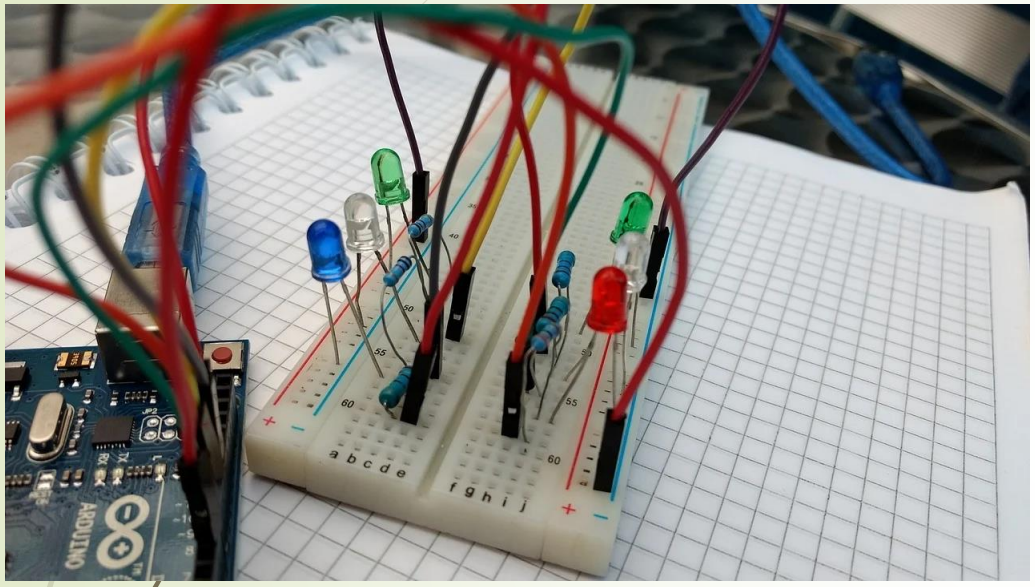
PCB DESIGNING WORKSHOP



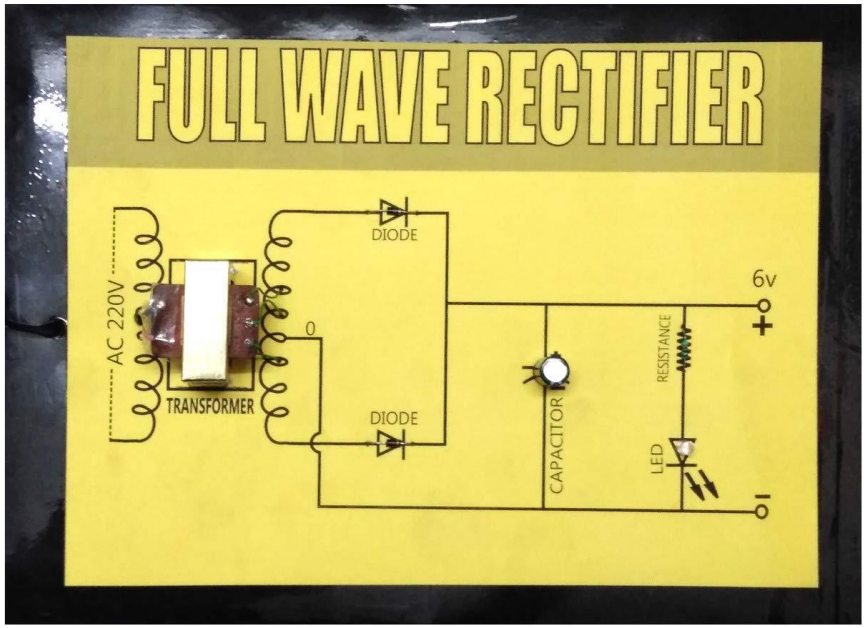
Content

- Circuit Design you already know
- Need for PCB
  - Market size and India's vision
- Importance of PCB Design as ECE students
  - Jobs Opportunities
  - Relevant Industries
  - Startup
- Flow of the workshop
- Design Contest for you
- Relevant Links

Designs you already know



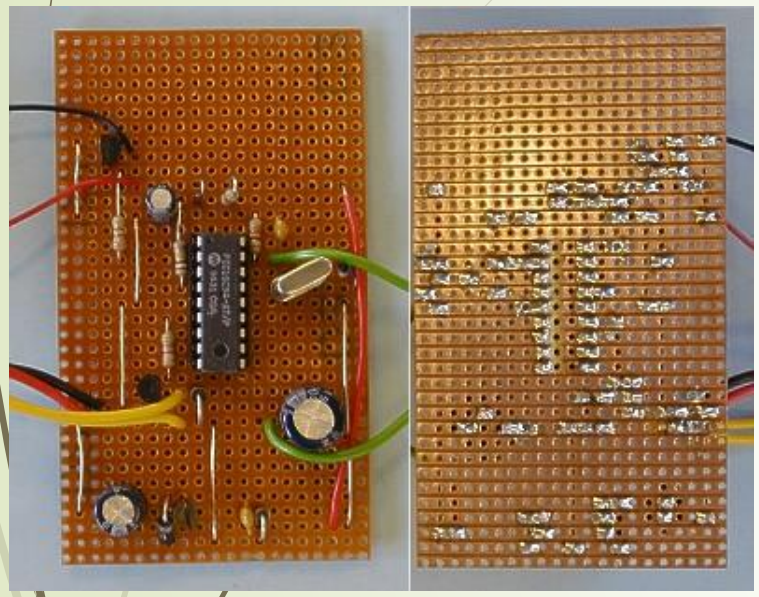
Breadboard



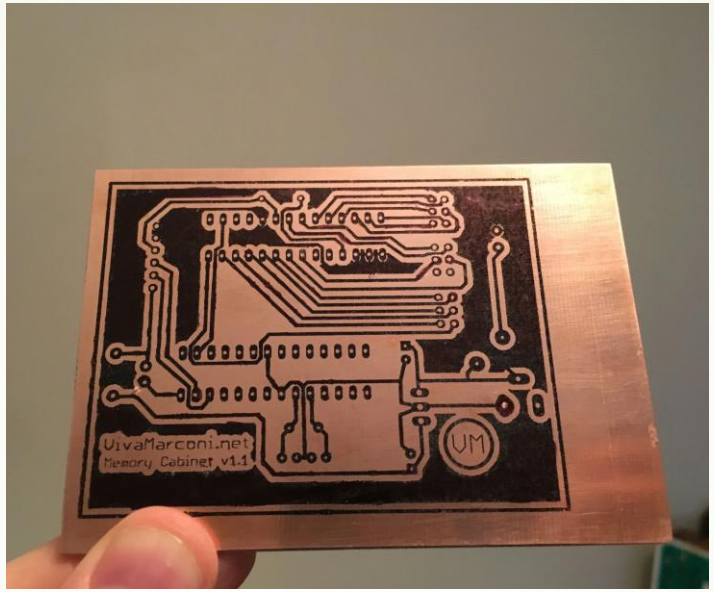
Wiring board

Activity1: List out the advantages and disadvantages of breadboard

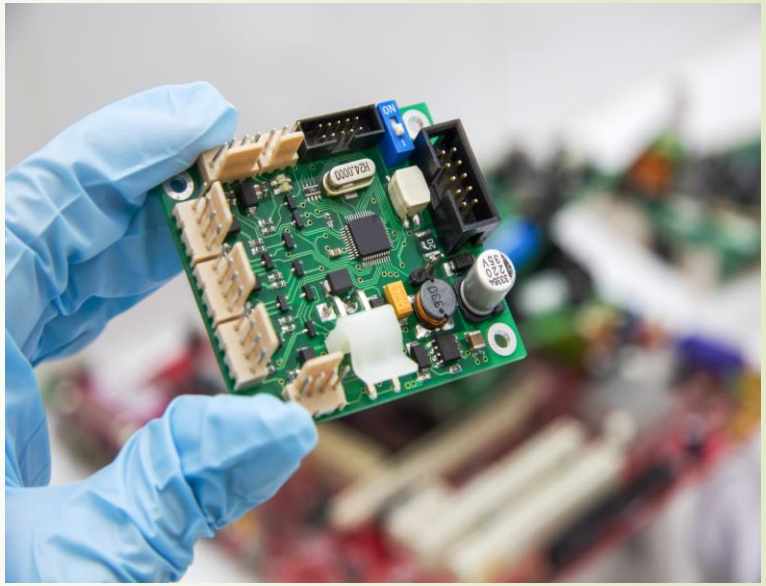
Other types of Designs



Strip Boards



Traditional
PCB board

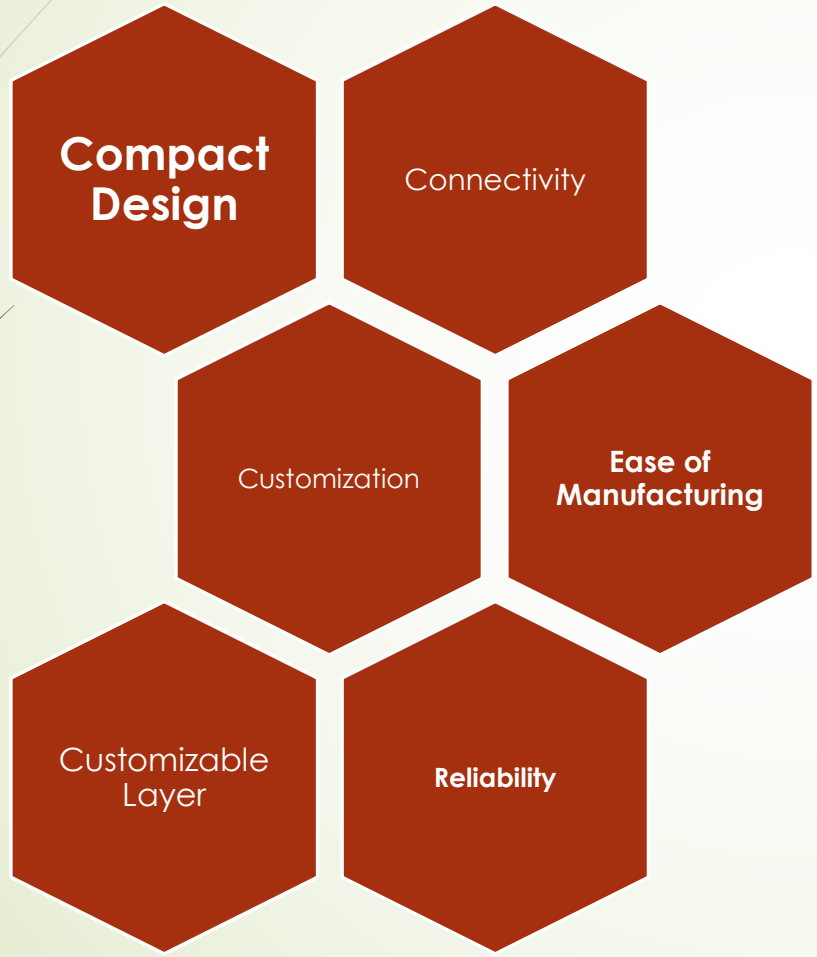


PCB board with
solder mask

What is PCB?

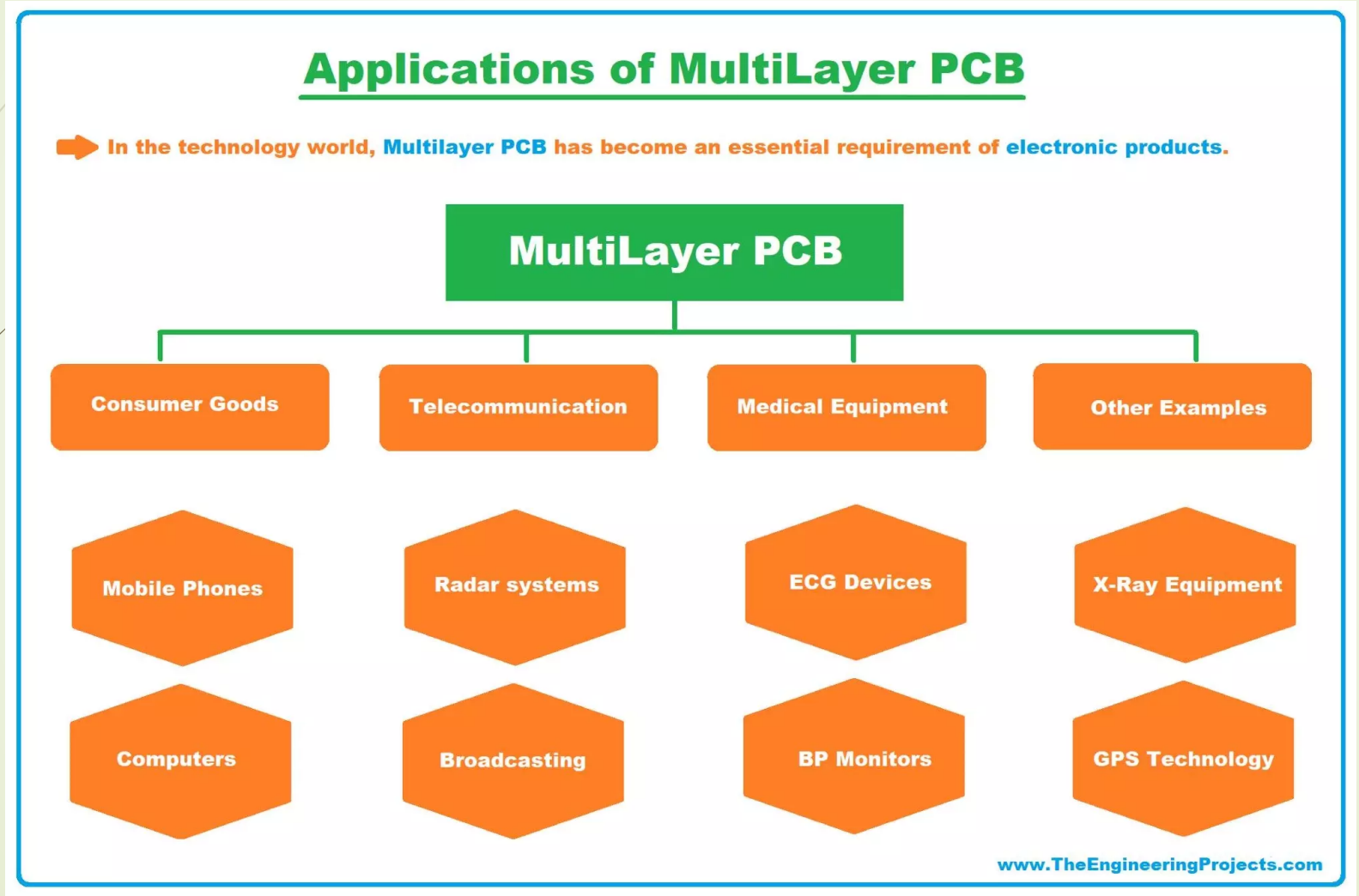
- Video Link

Advantages of PCBs

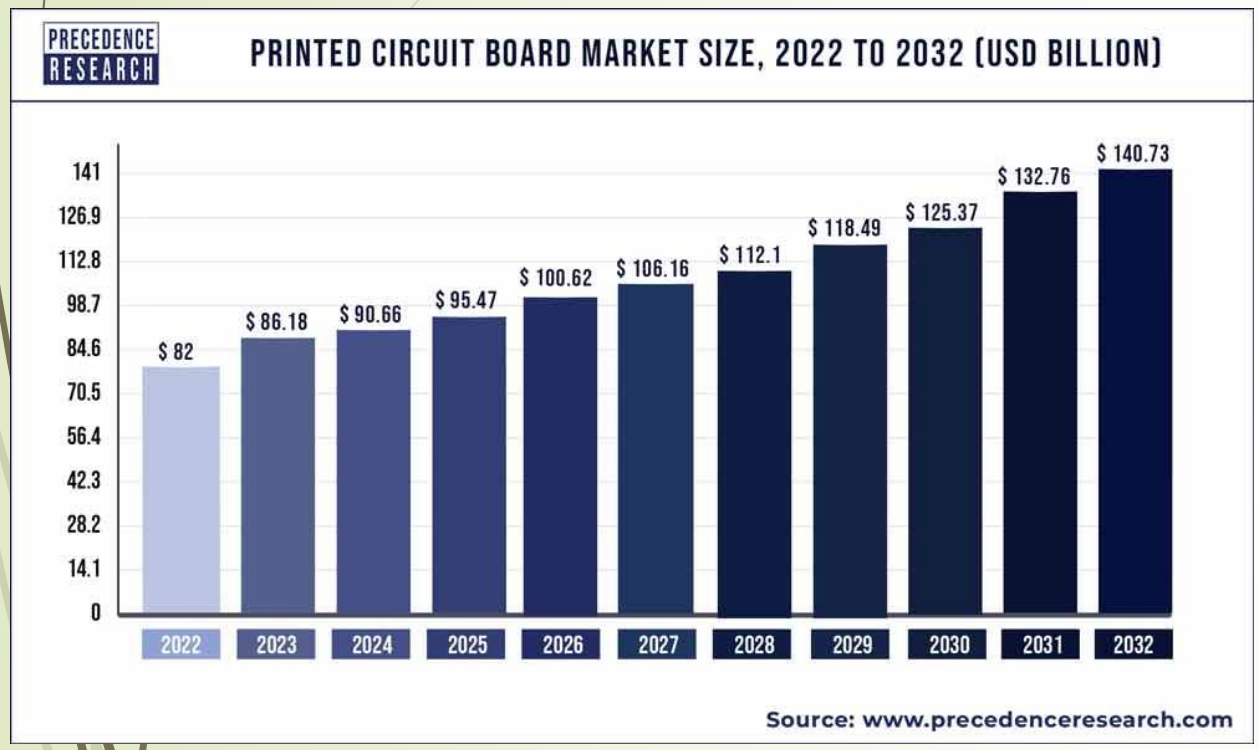


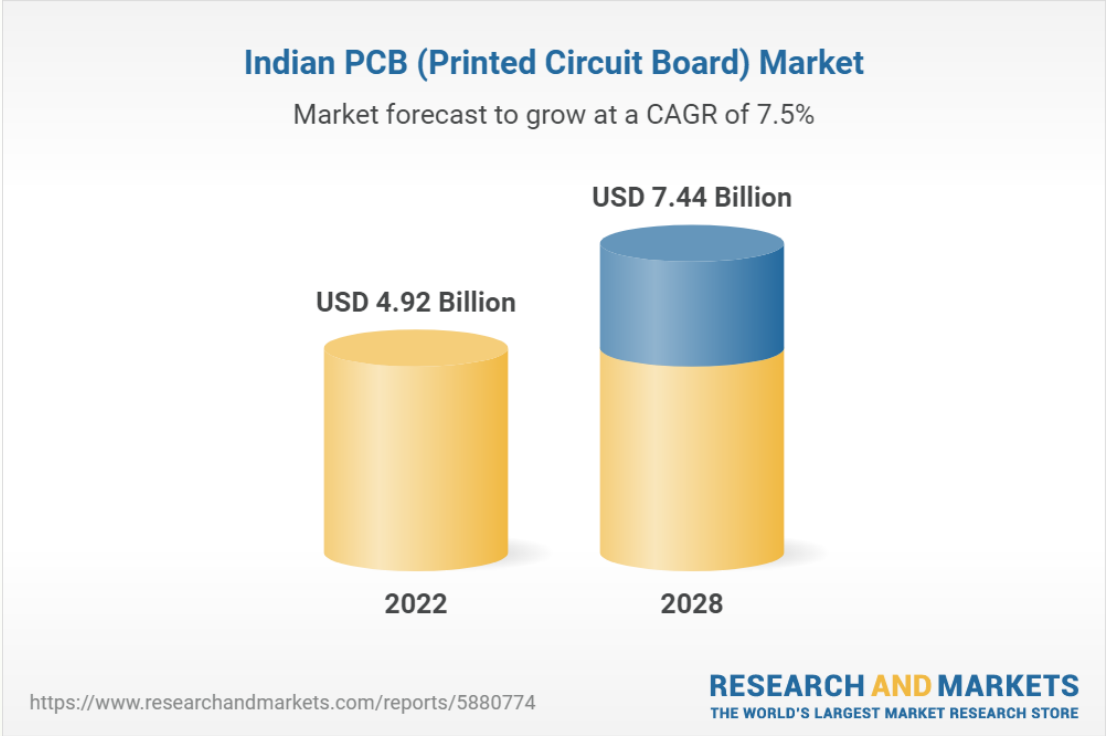
Activity2: List out the items present in the class which contains PCB

Application of PCBs

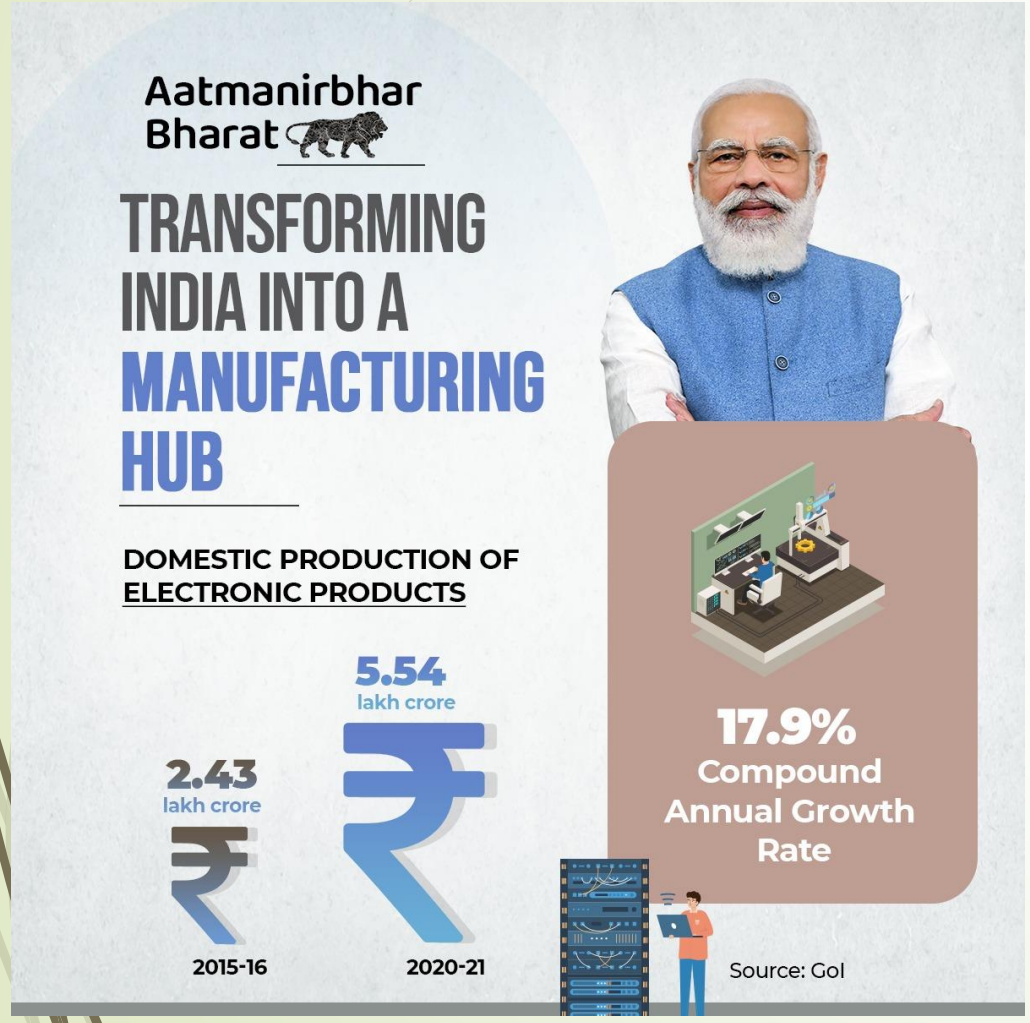


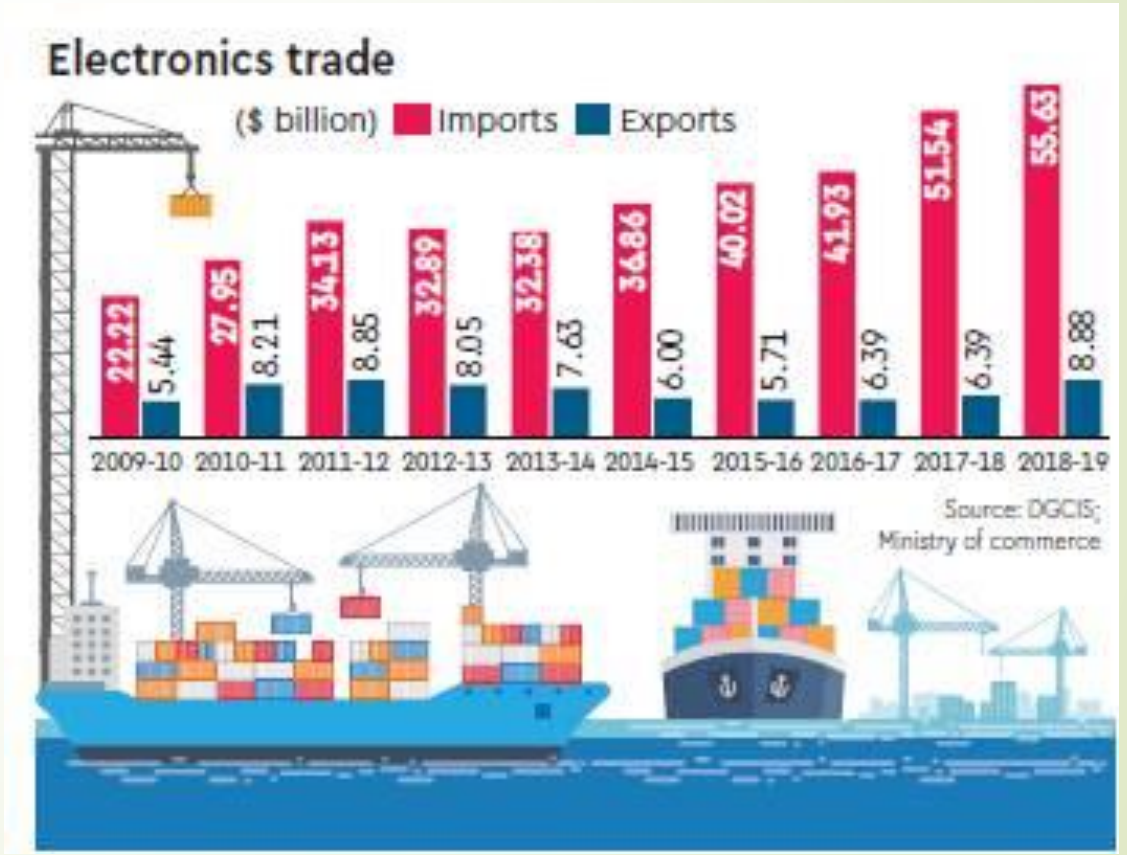
Need for PCB and market size





India's Vision

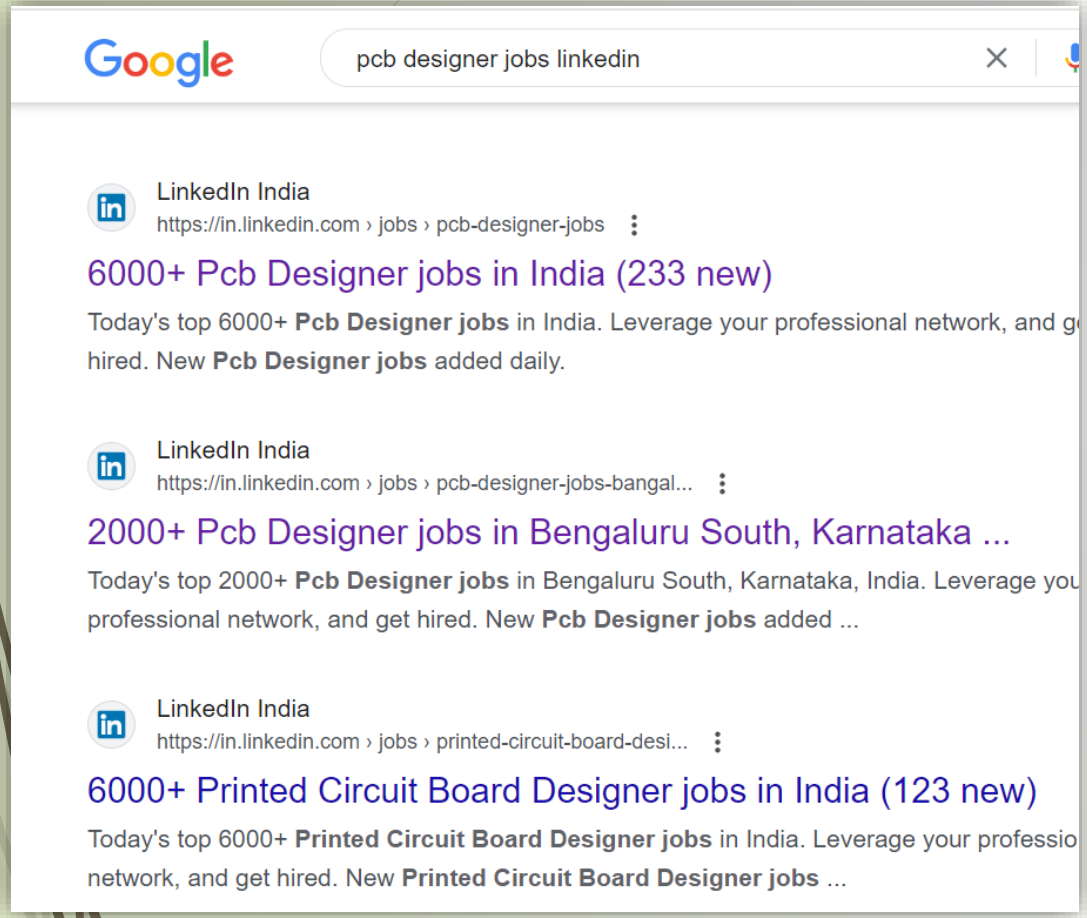


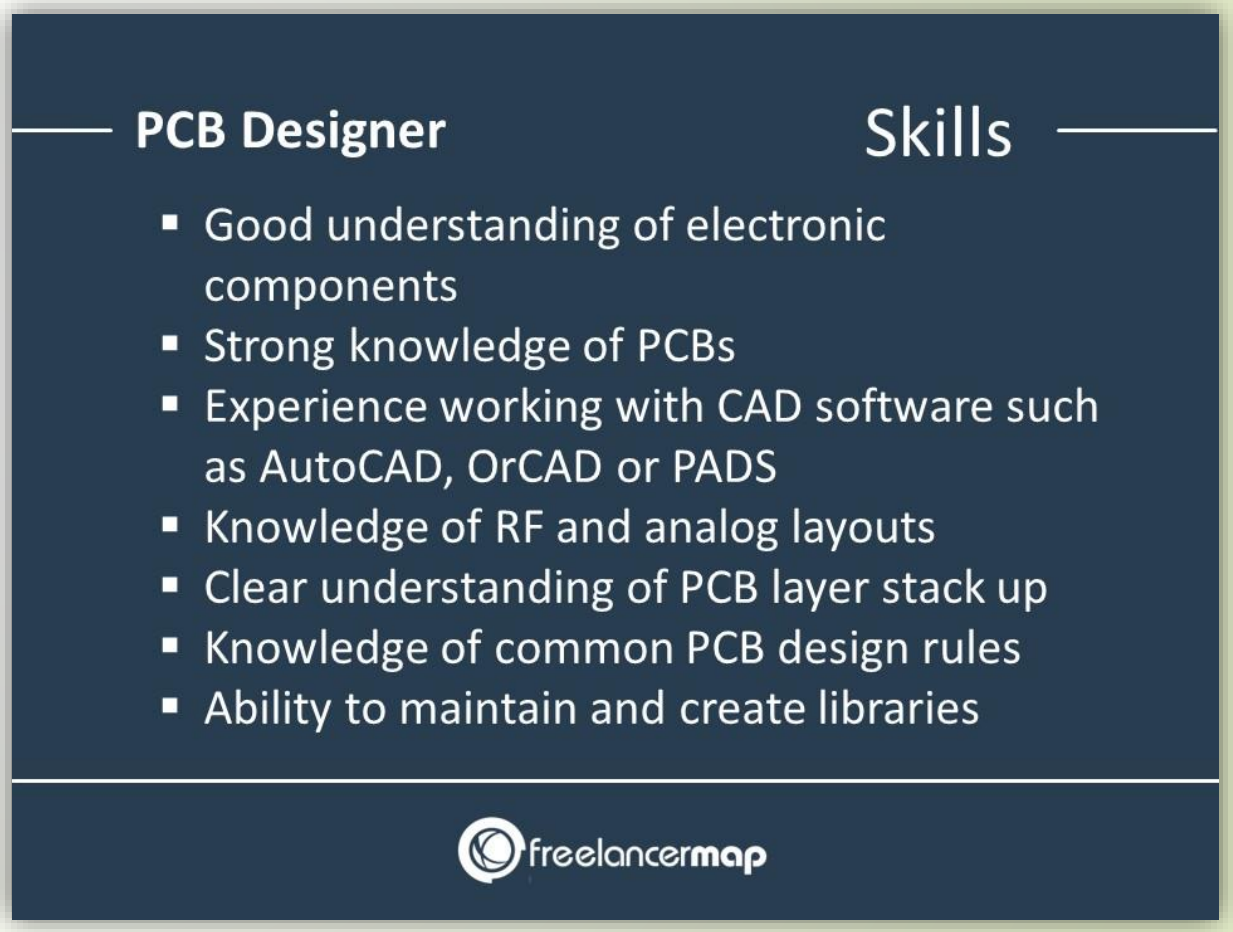


PCB Manufacturing Proecss

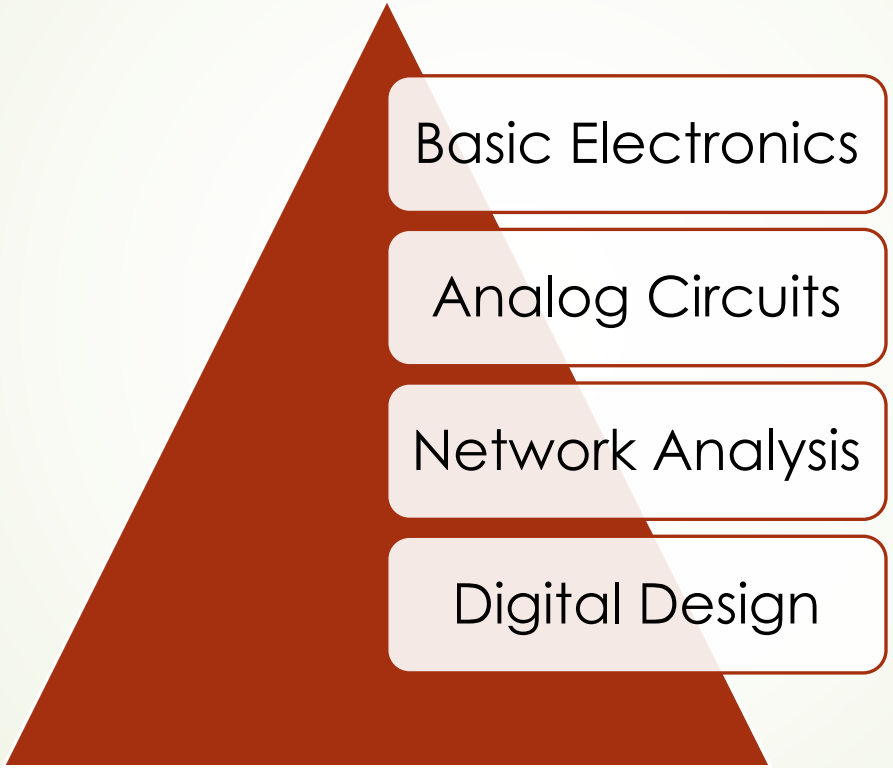
- Video Link

Importance of PCB Design as ECE students





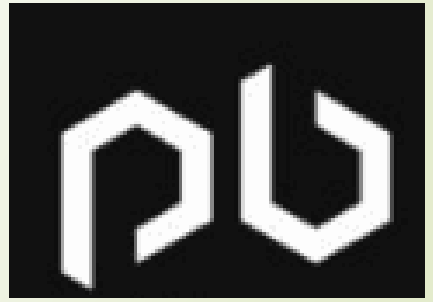
Domain knowledge Required



Relevant Core Industries in India

Top 10 PCB Industry in India

Indian Startups in PCB designing

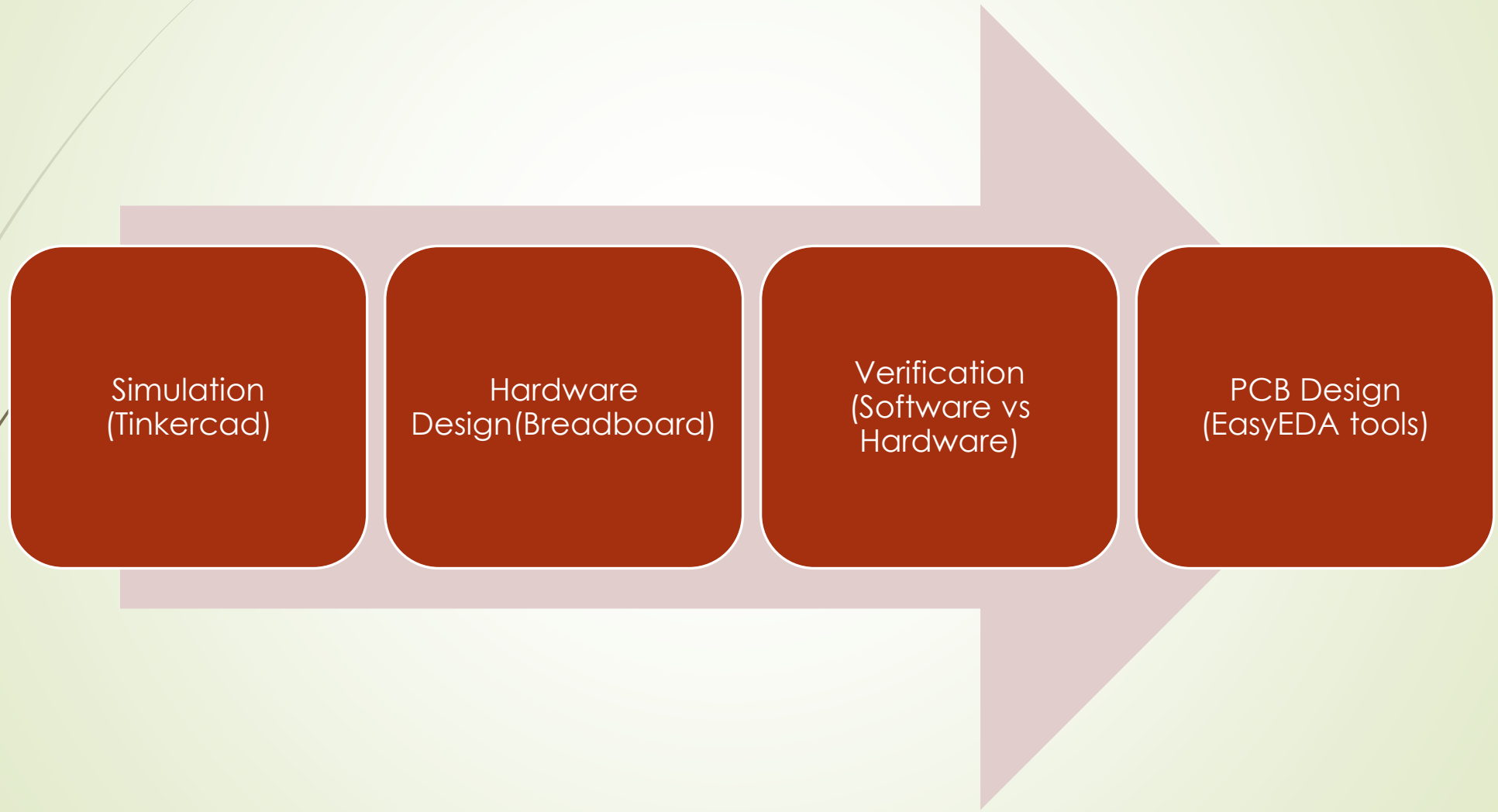


Poll: Which country is the second best PCB board manufacturer after China?

- A) Japan
- B) Taiwan
- C)Korea
- D) USA

Plan of Workshop

Flow of the workshop

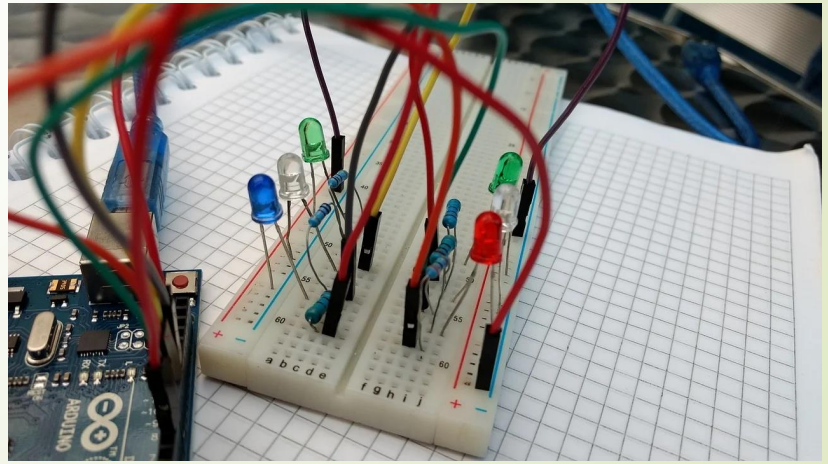


Simulation (Tinker-cad)

- Divide into Team of four
- Join with CLASS CODE
- Hand-holding with sample problems statements to begin with.
- Verify schematics and BOM
- Problem Statements for intra-group competition
- Groups with completed task to go for hardware design on breadboard

Breadboard Designing

- Groups will be heading to designated rooms (BEEE/AC lab)
- Collect relevant components from lab instructors
- Connect the circuits and take reading and verify it with simulation results.
- Take pictures for report writing.
- Return to class after completion of lab.

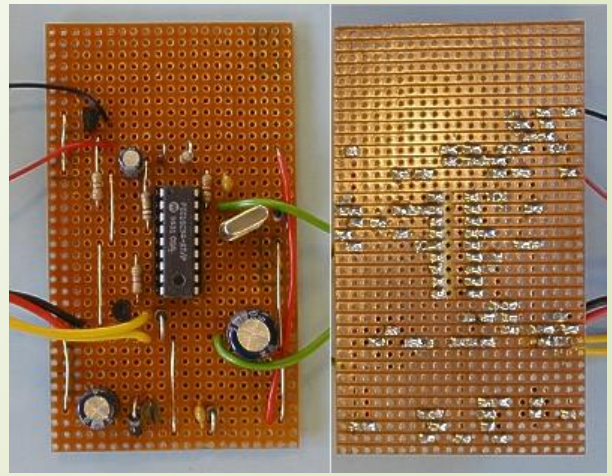


Circuits using PCB

- **Design Your Circuit**
  - Sketch it out and decide on the placement of components
  - Consider the arrangement of components
  - Visualize how the traces
- **Insert Components**
  - Insert your components into the holes
  - Align them according to your circuit design
  - Use a lead forming tool or wire cutter to create consistent link wires
- **Solder the Components**
  - Apply solder to the component leads and the copper strips.
  - Ensure good solder joints for reliable connections

Click for Details

Click for video tutorial



Circuits using Etching Technique

Item	Purpose
Copper-Clad Board (Substrate)	Base material with a thin layer of copper for creating traces and connections.
Etching Solution (e.g., Ferric Chloride)	Removes unwanted copper during the etching process.
Protective Gear (Goggles, Gloves)	Safety equipment to protect against etching chemicals.
Soldering Iron and Solder Wire	Used for soldering components onto the PCB after etching.
Glossy Paper or Transparency Film	Printed layout for transferring the circuit to the copper-clad board.
Drill Machine and Drill Bits	Drills holes in the copper-clad board for component placement.
Steel Wool or Sandpaper	Removes ink from the etched PCB, revealing copper traces.

Circuits using Etching Technique(contd.)

Click for Video Tutorial Part 1

Click for Video Tutorial Part 2

- **Design Your PCB:**
  - Design the circuit schematic using software like EagleCAD, KiCad
  - Print your PCB layout onto glossy photo paper using a solid ink printer
- **Prepare the Copper Clad Board**
  - Cut the copper-clad board to the desired size using a utility knife or scissors.
  - Sand the edges of the copper-clad to ensure a clean surface for etching.
- **Transfer the Circuit to Copper Clad**
  - Iron the printed circuit layout onto the copper-clad using a flat iron (similar to ironing clothes).
  - The heat transfers the ink from the photo paper to the copper surface.

Circuits using Etching Technique(contd.)

- **Start the Etching Process**
  - Prepare a solution of ferric chloride (FeCl3) in an etching tray.
  - Immerse the copper-clad board in the solution for about 15 to 20 minutes.
  - Agitate the solution occasionally to ensure even etching.
  - The ferric chloride will remove the unwanted copper, leaving behind the circuit traces.
- **Rinse, Clean & Inspect the PCB**
  - Scrub off the ink using a scratch pen or abrasive pad.
  - Inspect the board to ensure that all traces are intact and there are no shorts or breaks.
- **Drill Holes for Components**
  - Use a hand drill with appropriate drill bits (ranging from 3.2mm to 8mm) to create holes for components.
  - Drill holes at the designated positions based on your PCB design.
- **Finish the Board**
  - Assemble your components, solder them onto the board, and complete your circuit.

List of Circuits(Analog):

- Basics:
  - LED ON/OFF using Push Button
  - Series and Parallel Connections
  - Ohm's Law
- Moderate:
  - Half/Full Wave Rectifiers
  - Inverting and Non-inverting amplifiers using Op-Amps
  - Colpitt's/RC Phase Shift Oscillators
  - Two level Clippers and clampers
  - FM transmitter

List of Circuits(Digital):

- **Basics:**
  - Logic gate verification
  - Implementation of Boolean function using k-map and logic gates
- **Moderate:**
  - Half/Full Adder
  - Up/down counter using Flip Flop
  - 3:8 Decoder

List of Circuits(Mixed Signals):

- **Moderate:**
  - LED blinking using 555 timer
  - 3 bit flash ADC
- **Assignment:**
  - Each group will be assigned a hardware for ECE LABS to design the prototype in the next few weeks and submit the project report.
  - Example: Power Supply, Ammeter, Voltmeter, Multimeter, Function Generator

Way ahead...

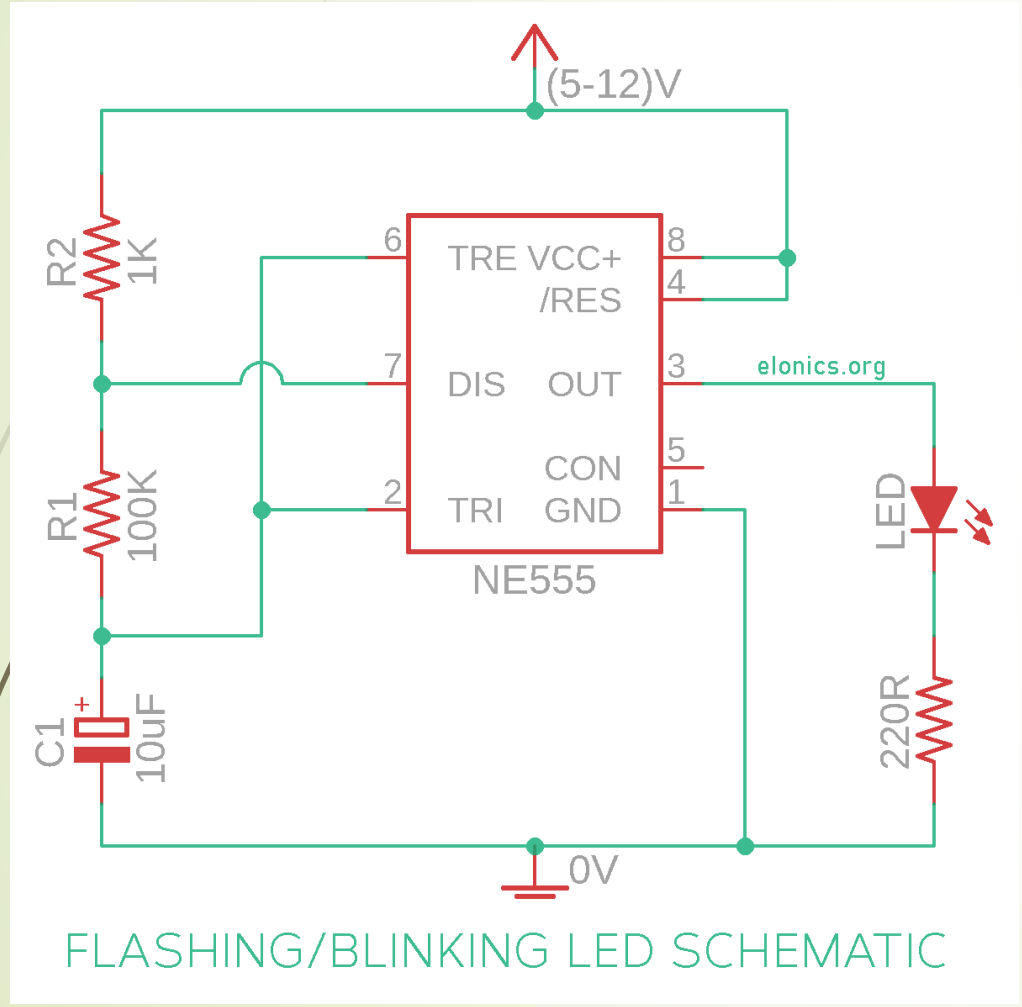
- Build lab hardware using reference from open hardware lab resources.
- Opensource our design for tech community across the nation for lab building
- Simulation, tesing and verification of the design
- Order the PCB board with TeamName
- Communicate research papers on the theme.

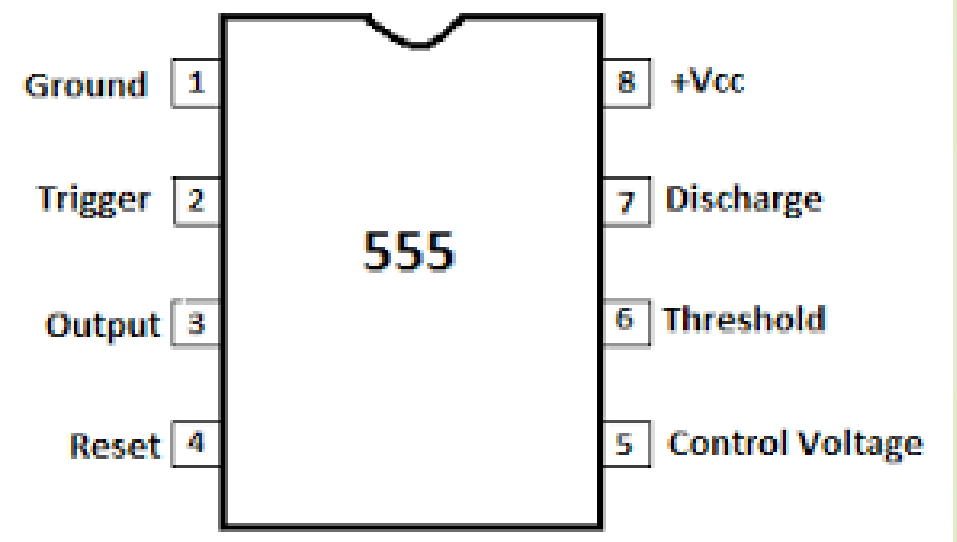
OSHW Lab
Open Source Hardware Lab

Design Contest

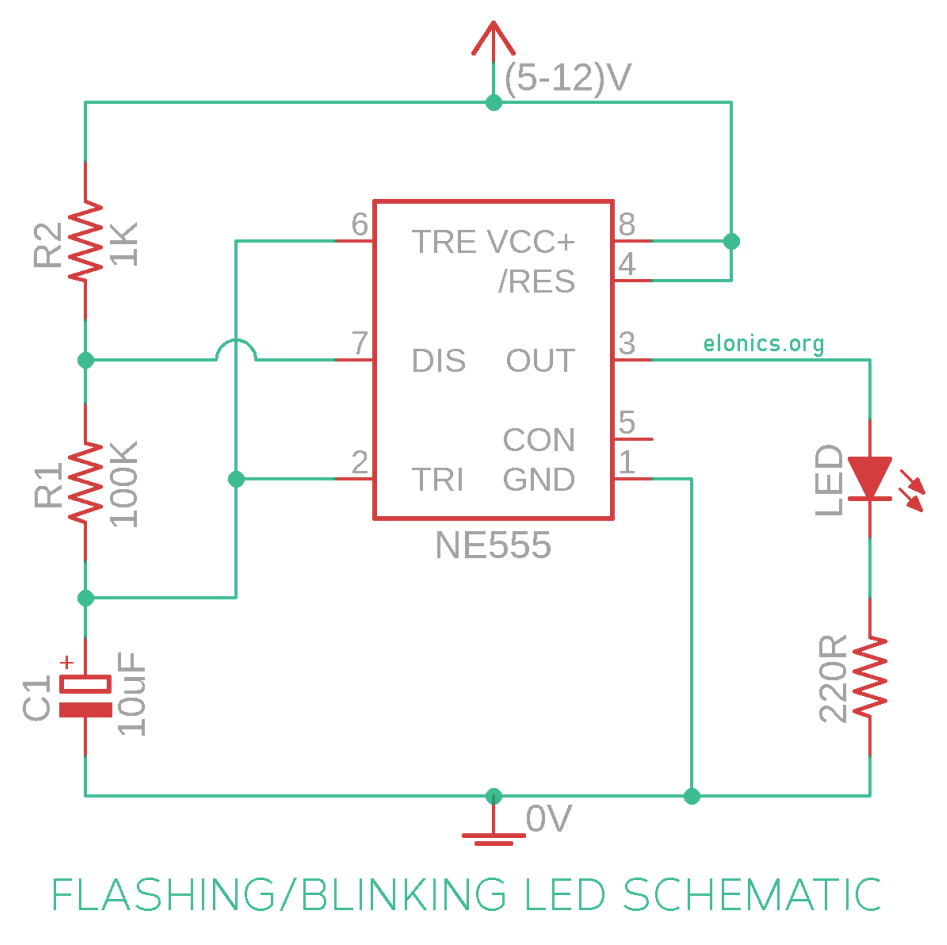
Sl. No.	Contest Name	Theme
1	PCBWay 5th PCB Design Contest	Next-Generation Hardware or Earth-Friendly Projects
2	IPC Design Competition	Virtual preliminary heat and in-person layout final
3	PCBWay 10th Badge Design Contest	Creative badge designs
4	Altium 365 PCB Design Review Competition	Identify errors in a given PCB design
5	PCBWay 6th Project Design Contest	Combine electronic and mechanical design for impactful creations
6	IPC Design Competition	Design test board for application of different companies

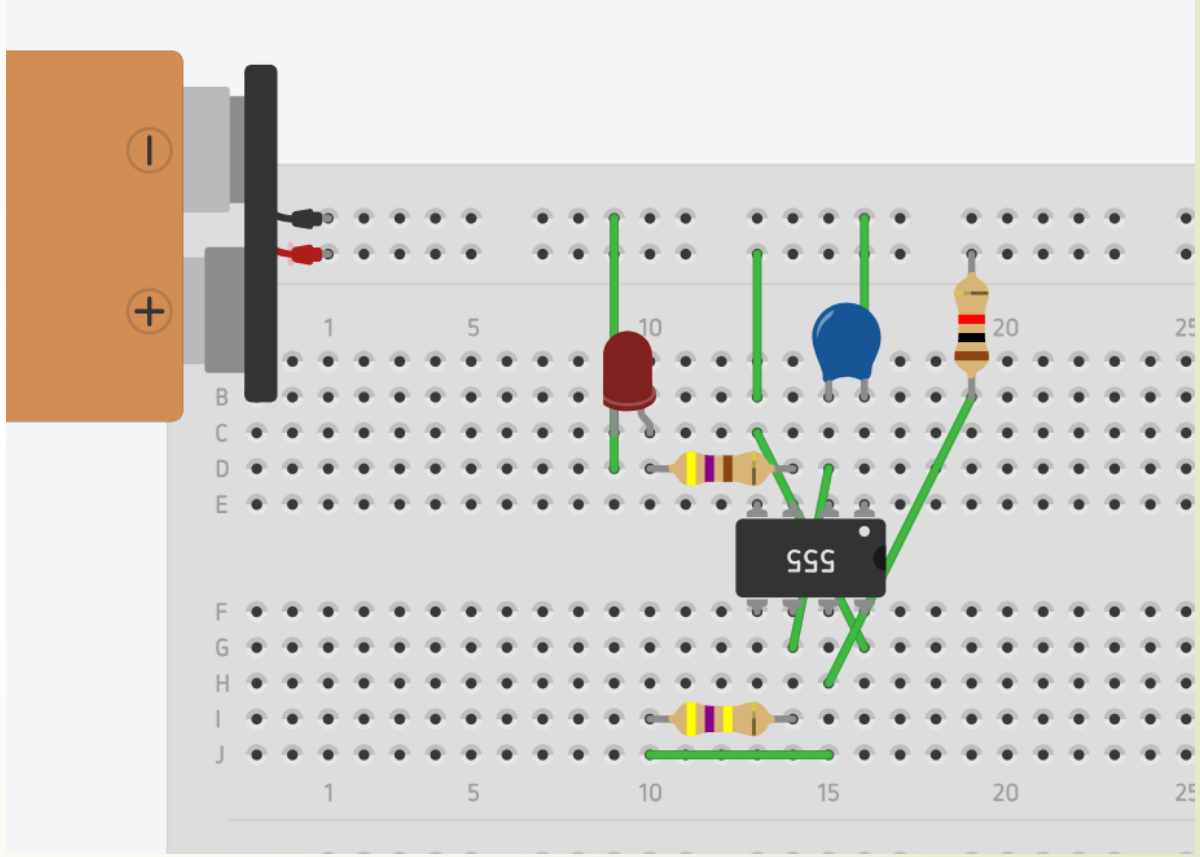
LED blinking using 555 timer



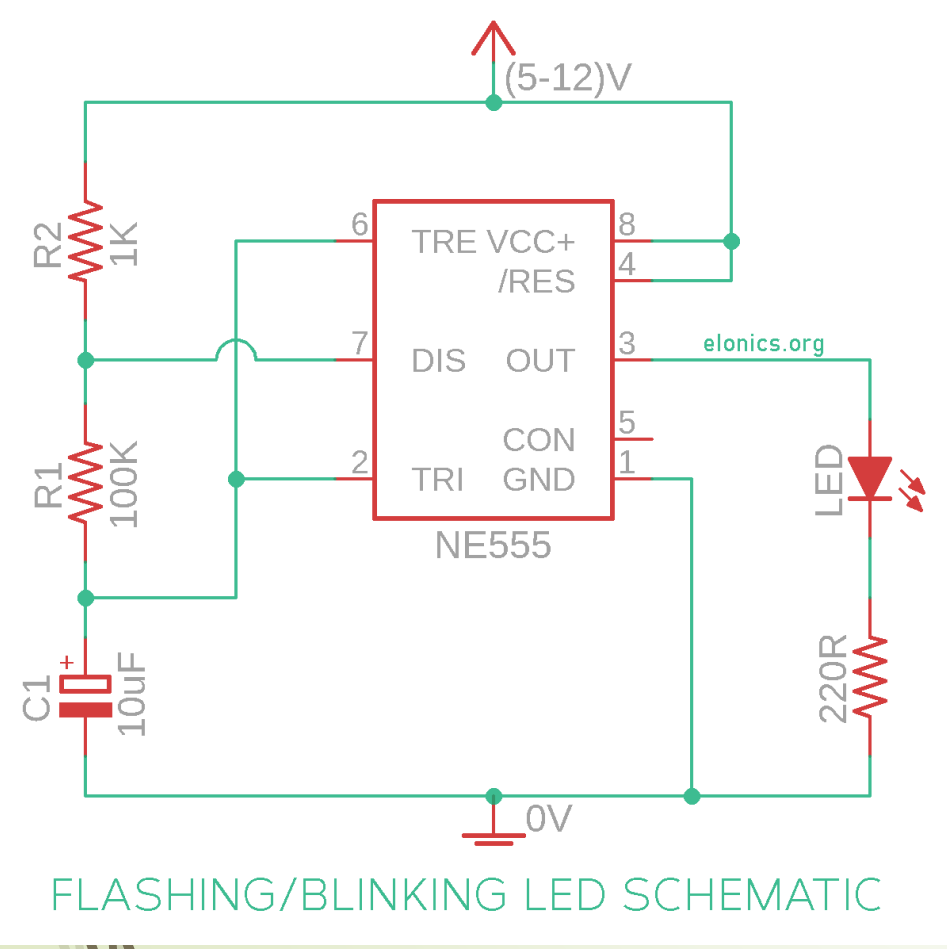


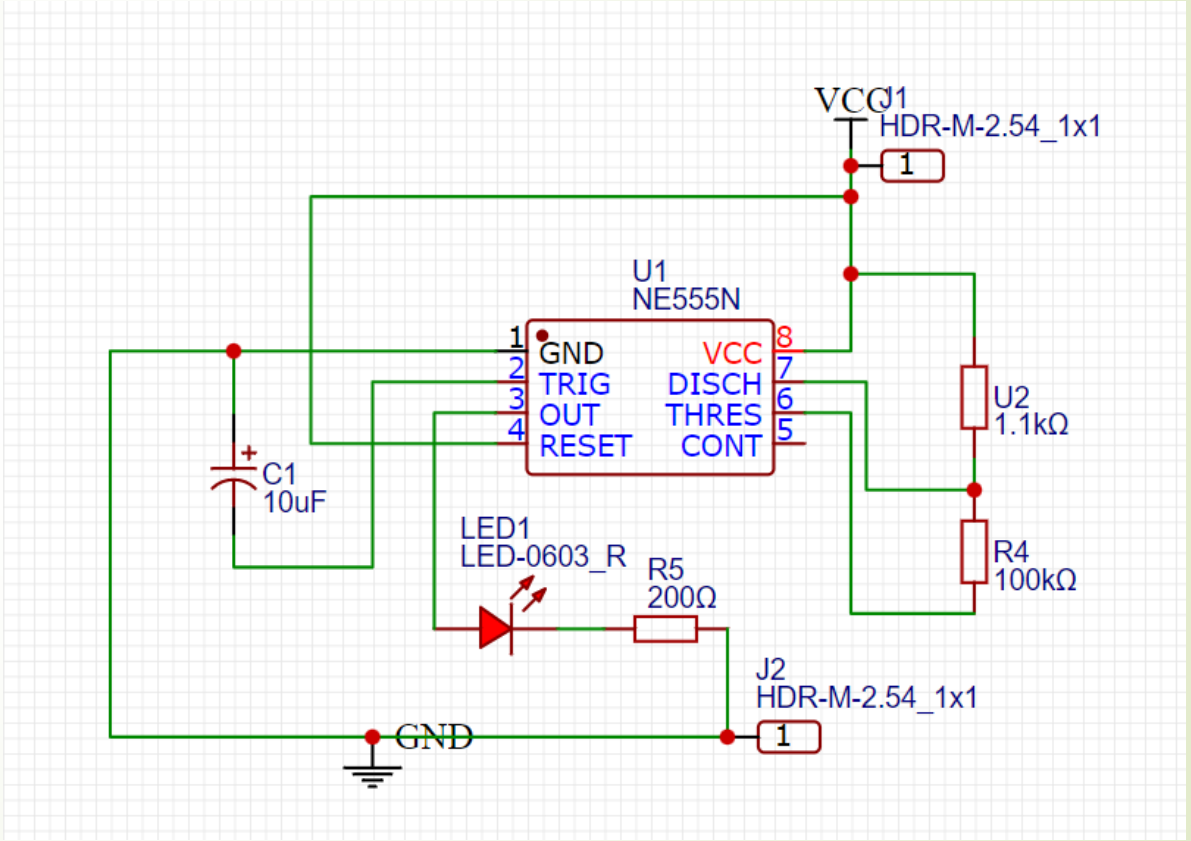
LED blinking using 555 timer



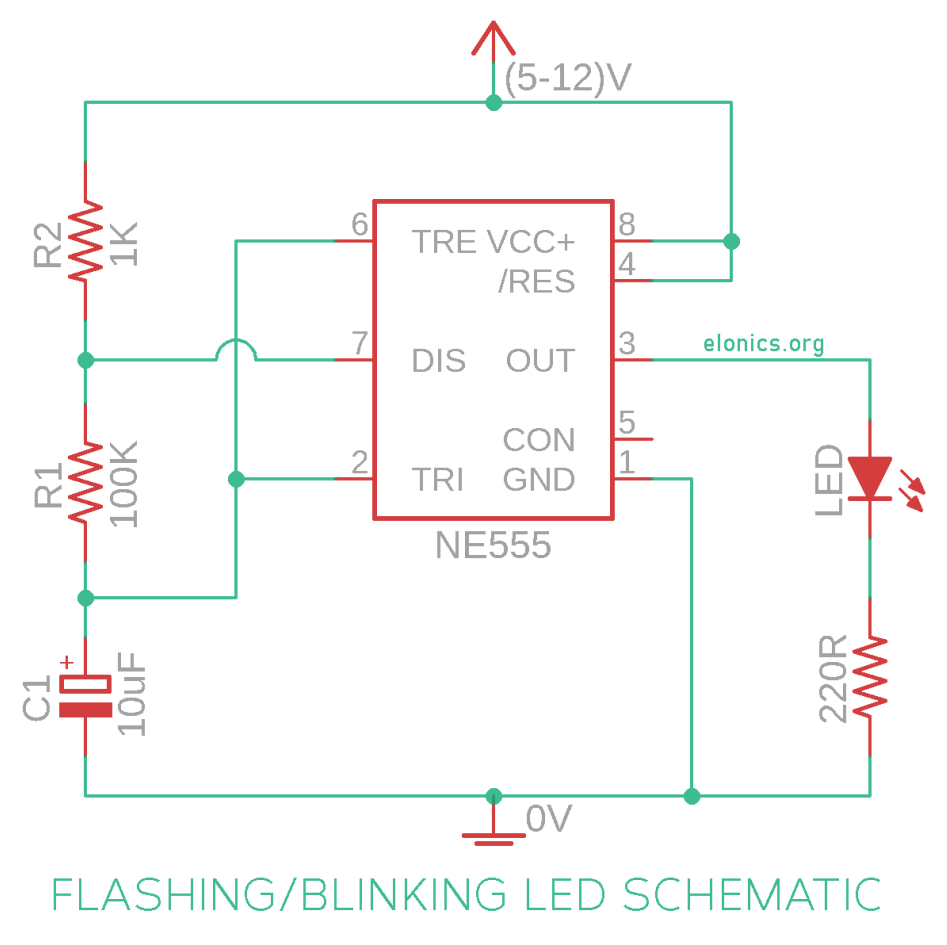


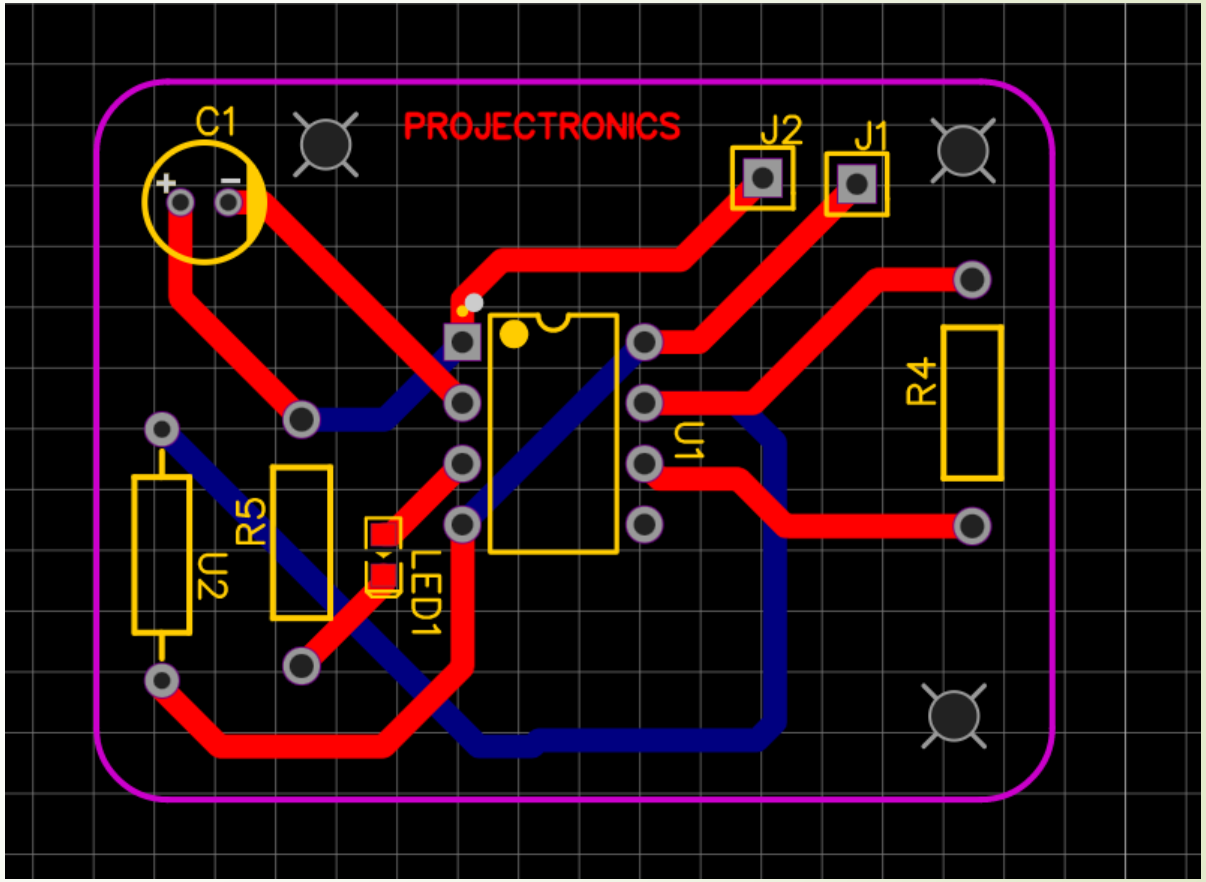
LED blinking using 555 timer



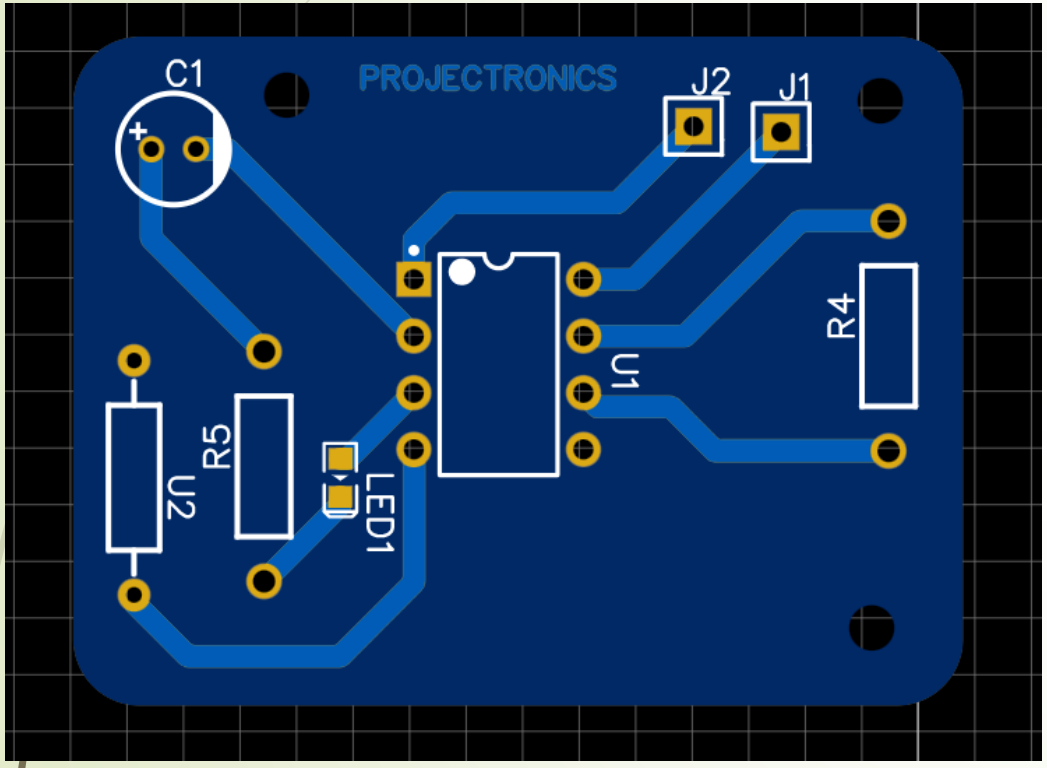


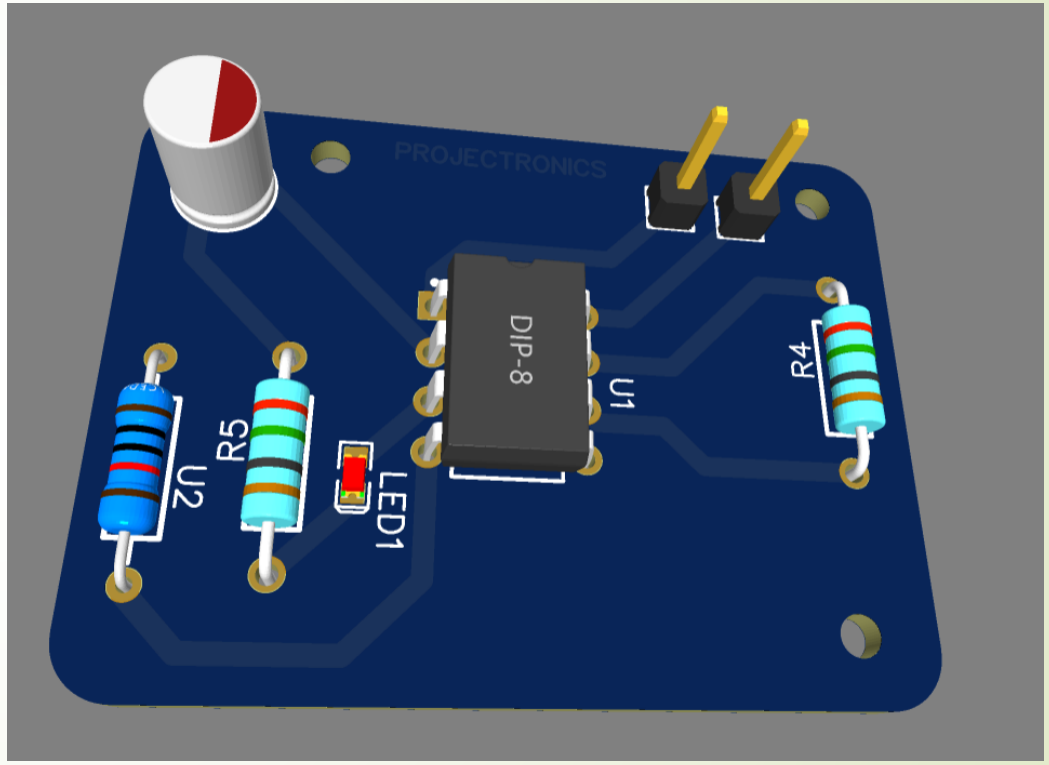
LED blinking using 555 timer



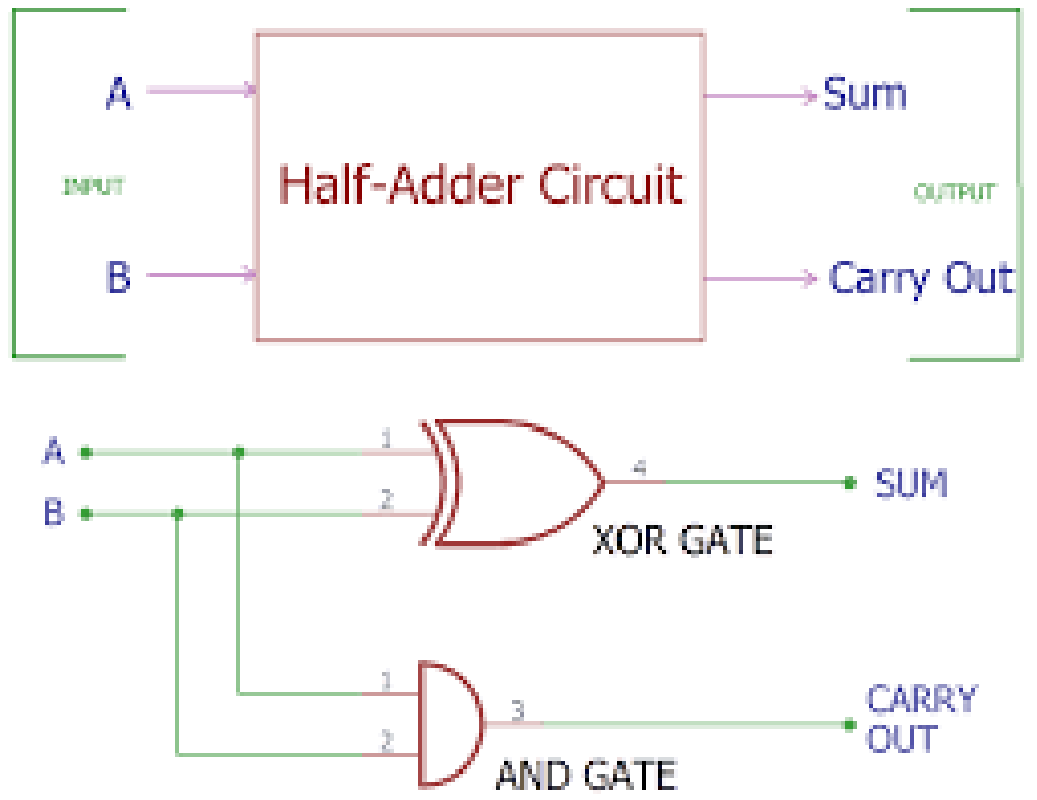


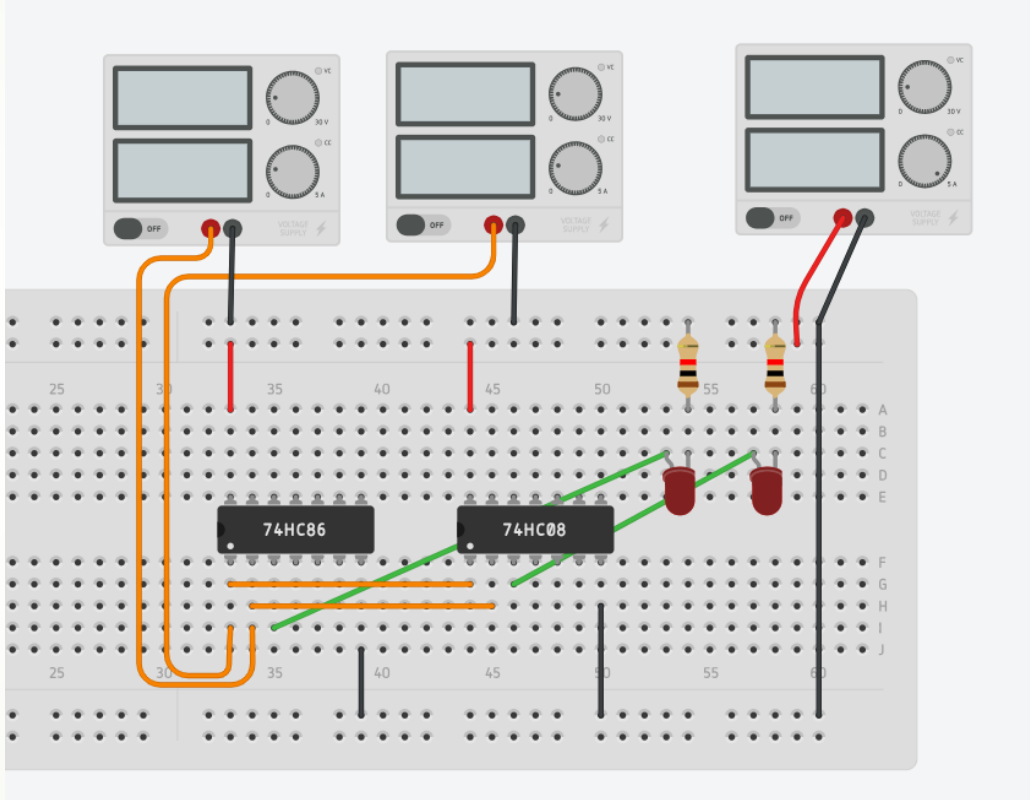
LED blinking using 555 timer



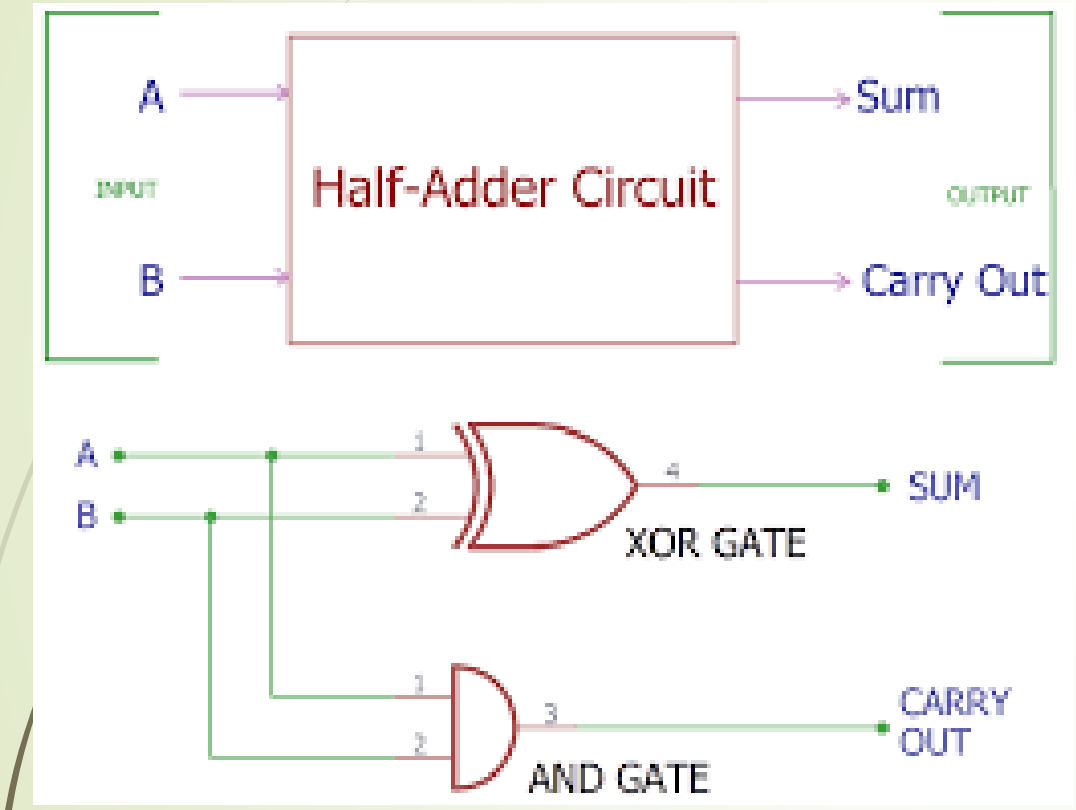


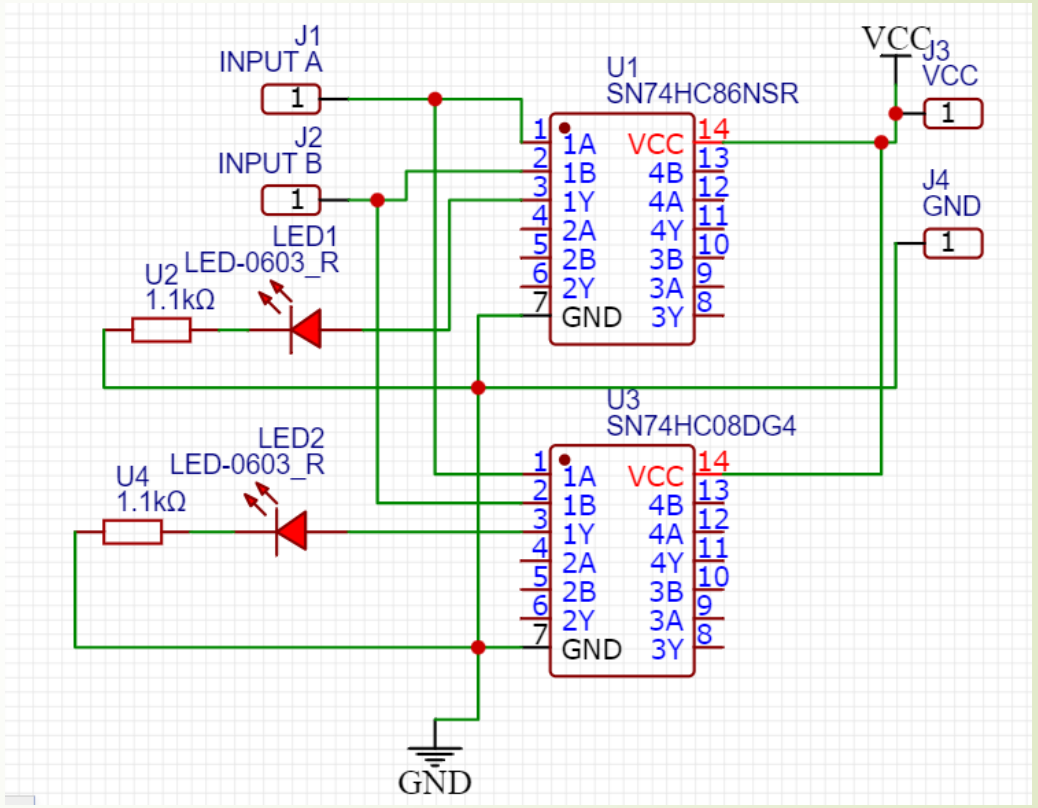
Half-Adder: Circuit and Tinkercad



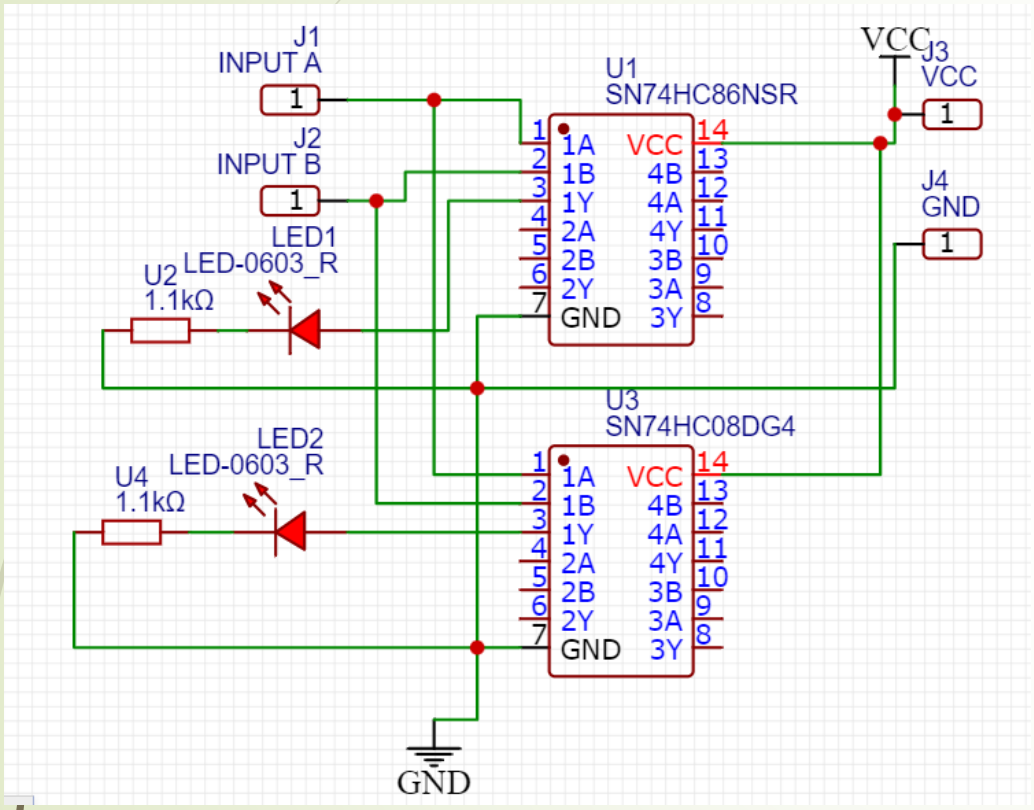


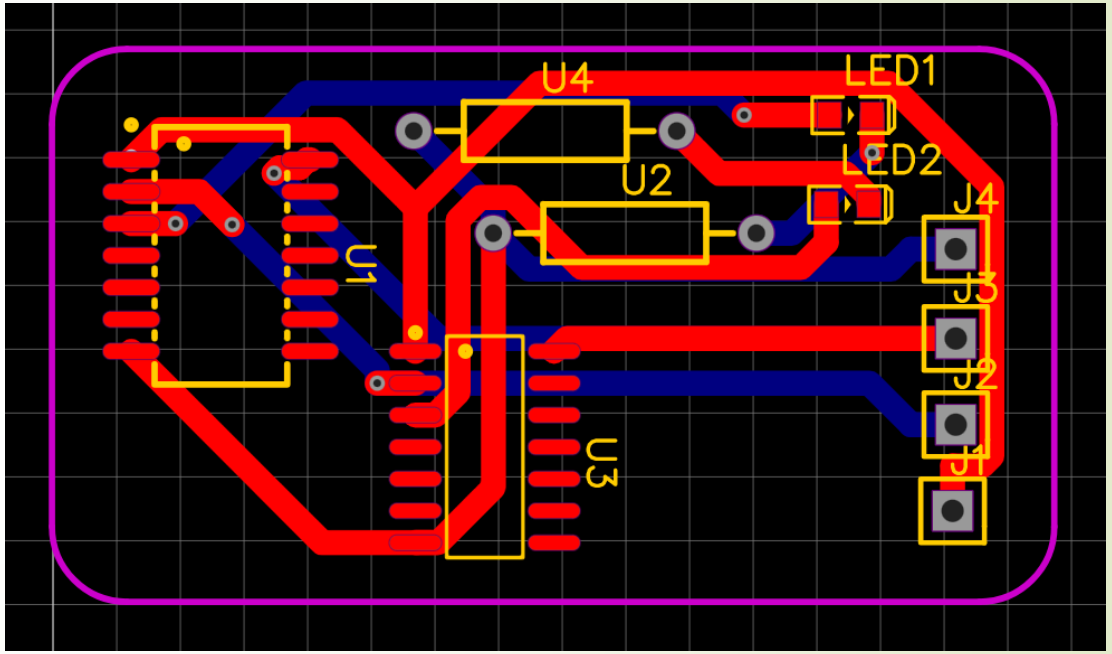
Half-Adder: EasyEDA circuit



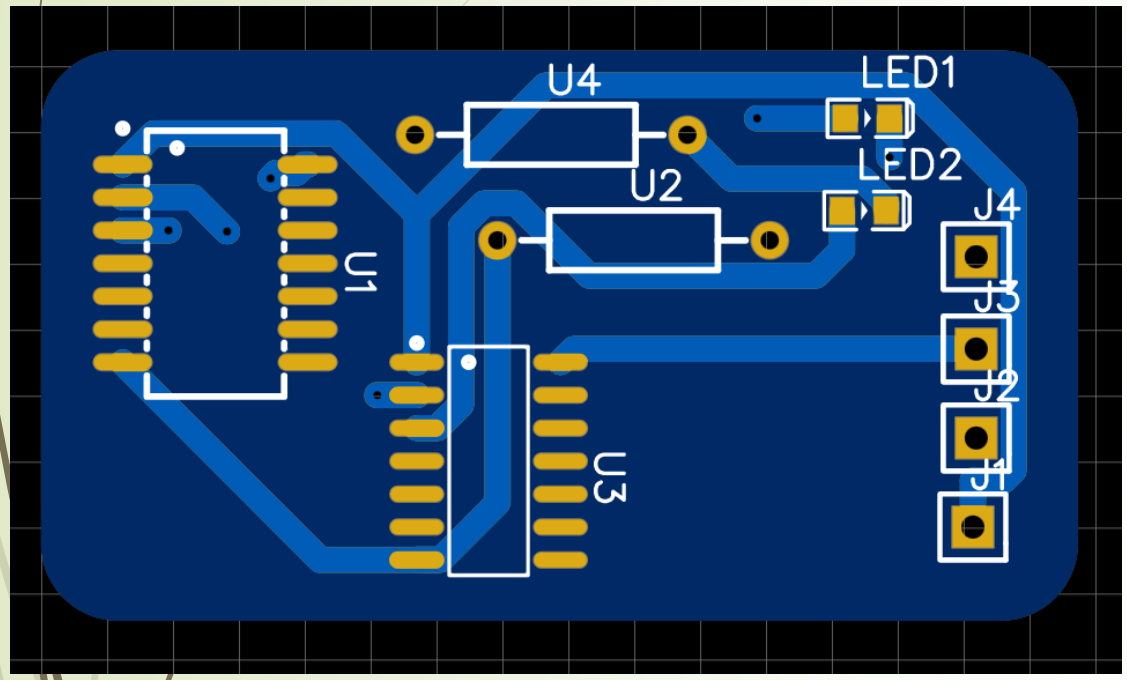


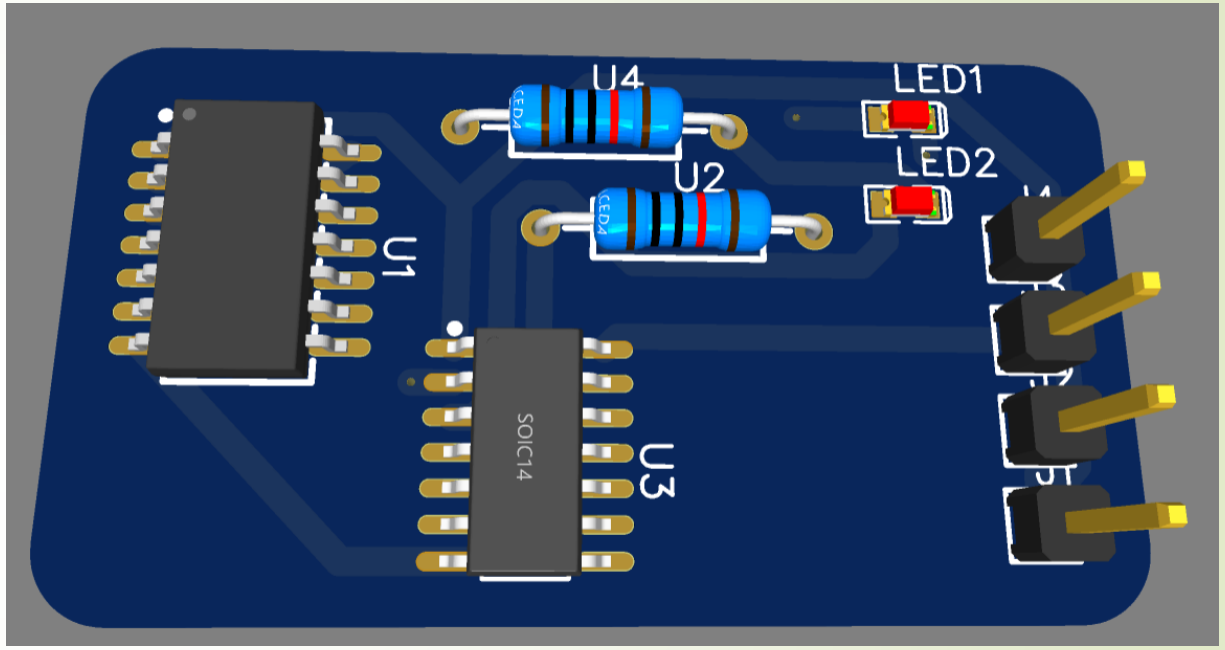
Half-Adder: PCB Schematic



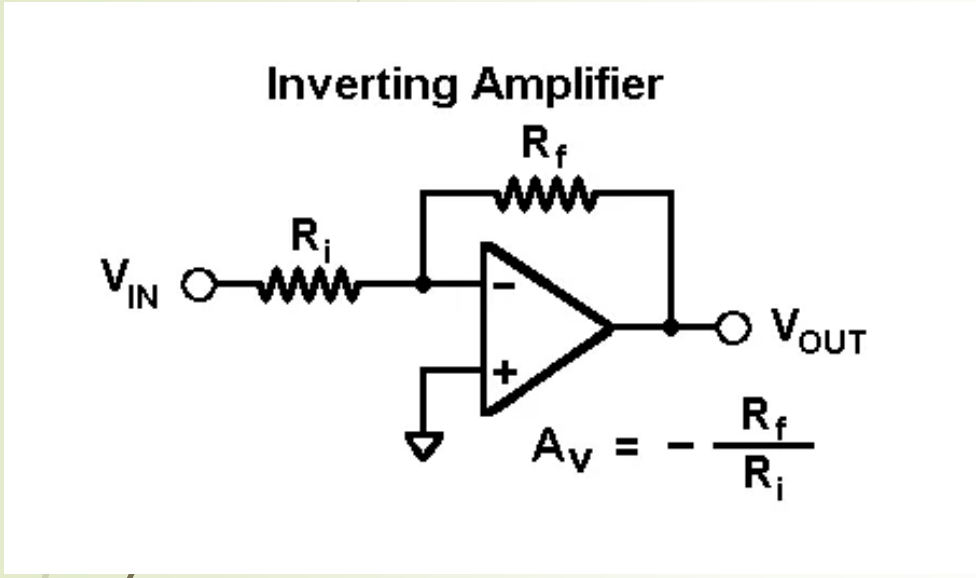


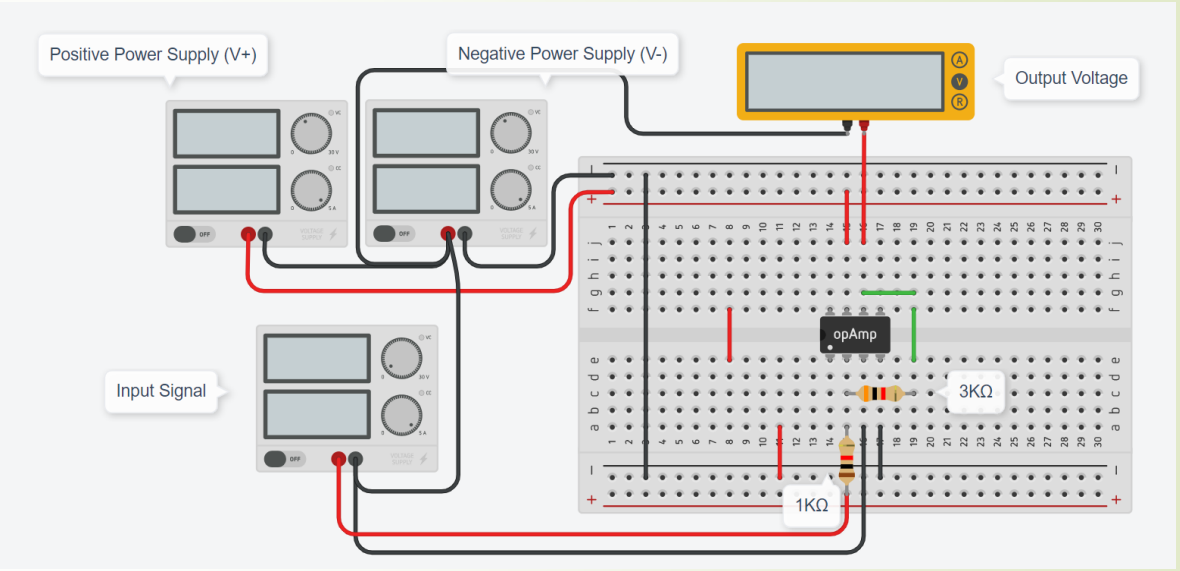
Half-Adder: 2D and 3D view



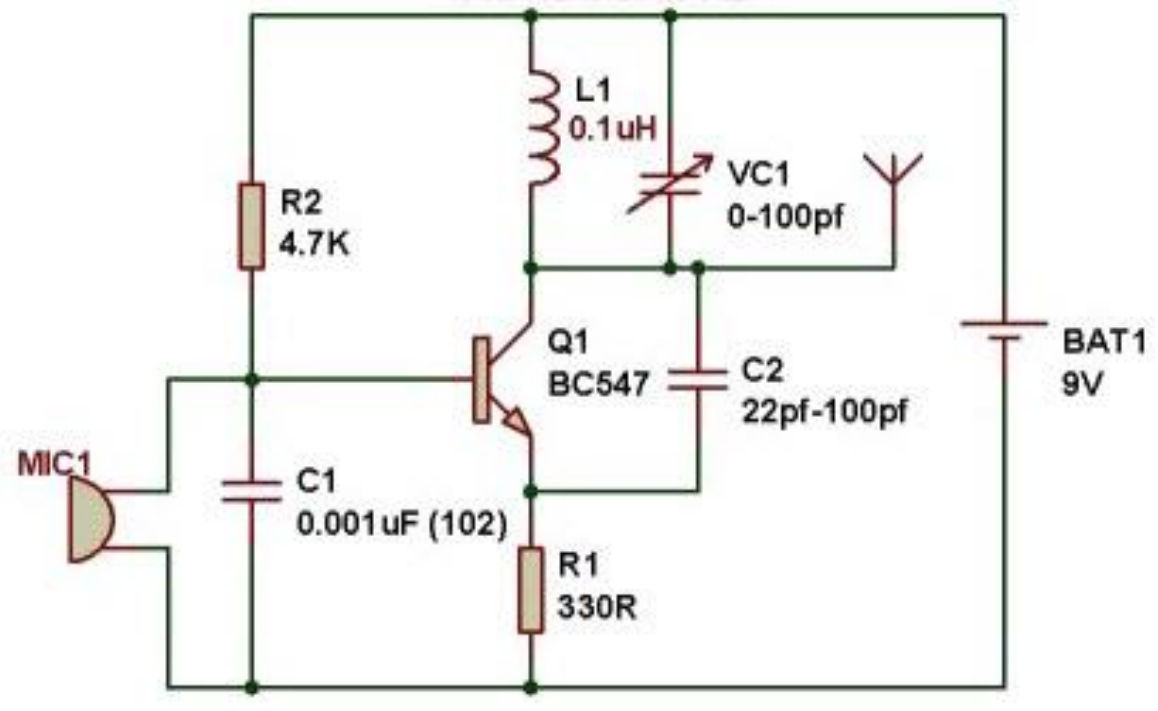


Inverting Amplifier using Op-Amp





FM Transmitter using single BJT



External Resources:

- Open Hardware Lab : https://oshwlab.com/
- Tinkercad classroom link: https://www.tinkercad.com/joinclass/A1MD2987T
- Instructable link:
  - https://www.instructables.com/Practical-Circuit-Construction-With-Strip-Board/
  - https://www.instructables.com/PCB-DesignTutorial-HowToDesign-Your-Own-PCBBoard/
  - First Example https://www.instructables.com/PCB-Designing-Using-EasyEDA/
- Youtube links:
  - https://www.youtube.com/watch?v=IRJ6YL_R8a8
  - How to Design & PCB Etching- Part 2 – YouTube