# 1.Abstract

This project focuses on the design and development of a mobile charging unit using a Silicon Controlled Rectifier (SCR) as the core component for controlling and regulating the output power. With the increasing dependency on mobile devices, the demand for efficient, safe, and cost-effective charging solutions has become more significant. This project addresses these needs by employing an SCR-based circuit to manage the DC output provided to a mobile phone during charging.

The system consists of several key components including a step-down transformer to reduce the AC mains voltage, a bridge rectifier to convert AC to DC, a filter circuit to smooth the rectified signal, and an SCR to regulate the voltage supplied to the mobile device. The SCR operates as a controlled switch, adjusting its conduction angle based on the input signal to maintain a stable output voltage. This approach offers an effective method of controlling power delivery without relying on complex voltage regulators or microcontrollers.

The use of an SCR in the charging circuit provides several advantages, such as improved control over voltage fluctuations, enhanced protection from over-voltage or over-current conditions, and a relatively simple and economical design. The project also explores the triggering mechanism of the SCR, which can be manually or automatically controlled depending on the requirements. Through experimental analysis, the performance of the mobile charging unit was evaluated under different load conditions, demonstrating stable and reliable operation suitable for basic mobile charging applications.

This project showcases the practical application of power electronics principles, particularly the use of thyristors like SCRs in real-world scenarios. It highlights how traditional electronic components can still play a vital role in modern consumer electronics when combined thoughtfully with simple circuit design. The mobile charging unit serves as a useful model for understanding controlled rectification, regulated power supply design, and basic load protection techniques.

# 2.Introduction

In today's technologically advanced world, mobile phones have become essential tools for communication, information access, and personal productivity. With this widespread usage, the need for reliable and efficient charging solutions is more important than ever. While commercial mobile chargers are widely available, many of them lack built-in protection or regulation mechanisms, which can lead to reduced battery life or even damage to mobile devices. This project aims to address these issues by developing a mobile charging unit that incorporates basic power control and protection features using a Silicon Controlled Rectifier (SCR).

SCRs, a type of thyristor, are widely used in power electronics for controlling and rectifying alternating current. Their ability to switch and regulate large amounts of power using small control signals makes them ideal for use in power supply circuits. In this project, the SCR is employed to control the output voltage supplied to the mobile device, ensuring safe and efficient charging. The SCR's gate triggering mechanism allows for precise regulation of the conduction period, thereby controlling the average voltage output of the circuit.

The charging unit is designed around a conventional power supply architecture consisting of a step-down transformer, a bridge rectifier, a filtering stage, and an SCR-based regulator. This combination provides a cost-effective and straightforward solution for supplying DC power from an AC mains source. The circuit ensures that the voltage supplied to the mobile device remains within safe operating limits, and the SCR acts as a safeguard against possible over-voltage or over-current conditions.

This project not only demonstrates a practical application of SCRs in low-power electronic circuits but also provides a hands-on understanding of power control techniques in mobile charging applications. The simplicity, effectiveness, and affordability of the design make it a valuable learning tool for students and hobbyists interested in power electronics and circuit design.

# 3.Proposed Methodology

The development of an SCR-based battery charger was approached through a systematic and well-structured methodology, aimed at ensuring the design was not only functional but also safe, efficient, and suitable for practical implementation. The objective of this project was to create an automatic battery charging circuit capable of detecting the battery's charge level and disconnecting the supply once a full charge is reached, thereby preventing overcharging. Overcharging can significantly degrade battery life and, in some cases, pose safety risks. This need for an effective, automatic control mechanism formed the basis of the project, with the Silicon Controlled Rectifier (SCR) selected as the primary controlling device due to its excellent power handling and switching characteristics.

The initial step involved a thorough analysis of the requirements and constraints of the charging circuit. This included understanding the electrical characteristics of the 12V lead-acid battery typically used in such applications, determining the appropriate charging current, and establishing the voltage threshold for charging cutoff. Based on these parameters, a control strategy was devised where the SCR would act as a switch, allowing or blocking current flow to the battery depending on its voltage level. The key advantage of using an SCR is its ability to stay latched in the "on" state until the current drops below a certain holding value, making it ideal for this application.

Once the basic concept was outlined, suitable components were selected. A step-down transformer was used to reduce the 230V AC mains supply to a lower AC voltage, making it safer and more compatible with the battery's requirements. This was followed by a full-wave rectification stage using diodes, converting the AC voltage to DC. A filtering stage was incorporated to smooth out the ripple and provide a more stable DC output. The SCR was placed in series with the battery to control the charging path. A transistor-based sensing and control circuit was also designed, consisting of resistors, a Zener diode for voltage reference, and a variable preset (PR1) for fine adjustment. This control circuit monitors the battery voltage and, upon reaching a predefined threshold (typically 12V), activates the transistor, which in turn disables the SCR by removing its gate trigger signal.

To verify the theoretical operation of the circuit and make necessary adjustments before hardware implementation, the entire circuit was simulated using **NI Multisim**, a widely used electronics simulation tool. Through simulation, various test cases were applied, such as undercharged and fully charged battery conditions, to observe how the SCR responded to different voltage levels. This step was crucial in identifying potential issues in gate triggering, voltage sensing, or component tolerances that could affect real-world performance. The simulation allowed for iterative improvements and offered a clear visualization of circuit behavior without the risks of working directly with high-voltage hardware.

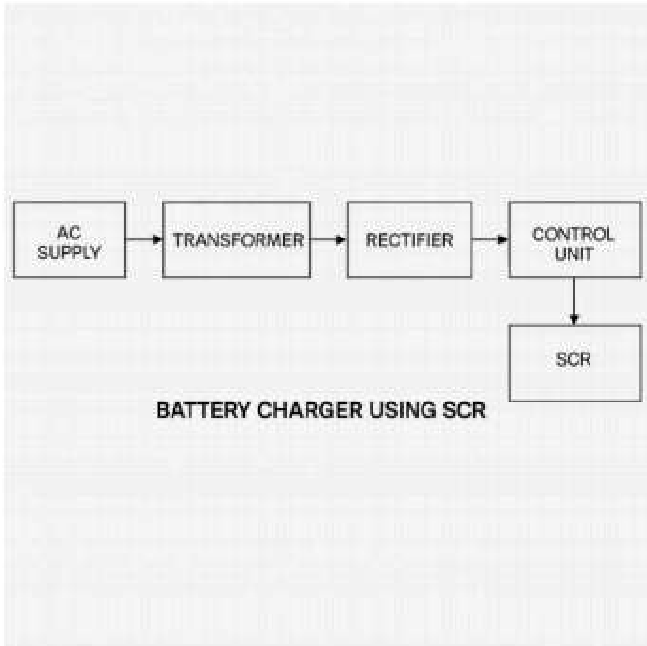
Following successful simulation results, the circuit was physically constructed using the selected components. The assembly was done on a breadboard for easy troubleshooting and modification. All components, especially the transistor and SCR sections, were carefully placed and wired according to the tested schematic. The preset resistor (PR1) was manually adjusted during initial testing to set the exact voltage at which the SCR should stop conducting. The Zener diode was chosen to establish a stable voltage reference, ensuring that the transistor only conducts when the battery voltage exceeds the set point.

Testing was conducted by connecting the output of the charger to a partially discharged 12V battery. As expected, the SCR allowed current flow during the charging phase. As the battery approached its full charge, the voltage across it increased, eventually activating the transistor circuit. This caused the SCR to stop receiving gate current, thus halting the charging process. A multimeter was used to monitor the battery voltage and confirm the automatic cutoff. The circuit was tested under different load and voltage conditions to ensure consistent performance.

Further analysis involved observing the temperature of the SCR and power dissipation across components under continuous operation. Safety enhancements were considered, including the possibility of adding a fuse or current-limiting resistor to protect the circuit against short circuits or component failures. Additional filtering could also be introduced to reduce voltage ripple at the battery terminals.

In the final stage, all observations, measurements, and design considerations were compiled into a comprehensive report. Diagrams, waveform screenshots from simulation, and performance graphs were included to support the results. This methodology not only helped in achieving the technical goals of the project but also provided a deeper understanding of controlled rectification using SCRs, automatic voltage-based control, and real-world circuit design challenges.

# Block Diagram




# 4.Components (along with Justification and Cost)

| S. No | Component | Specification/Part No. | Quantity | Cost |
|---|---|---|---|---|
| 1 | Transformer | Step-down (230V AC to 24V AC) | 1 | 350 |
| 2 | Diodes | 1N4007 (or equivalent) | 4 | 8 |
| 3 | SCR (Thyristor) | TYN612 /604 | 1 | 11 |
| 4 | Resistors | 22Ω, 330Ω, 1Ω, 820Ω, 100Ω(*2) | 6 | 18 |
| 5 | Battery | Mobile battery (e.g., 9V or 12V) | 1 | 20 |
| 6 | Transistor | BC548 | 1 | 5 |
| 7 | PCB or Breadboard | General purpose | 1 | 80 |
| 8 | Connecting Wires | - | As required | 45 |

## Justification

### AC Input & Transformer

- V1 (230V, 50Hz AC source): Provides the input power.
- T1 (Step-down transformer): Steps down 230V AC to a lower AC voltage suitable for charging (typically 12V or so depending on the design).

### Rectification and Control

- SCR (Silicon Controlled Rectifier): Acts as a controlled rectifier. It allows current to pass only when triggered. It helps regulate charging current.
- D3: Freewheeling diode or part of the rectifier. Ensures unidirectional current.
- R2 (22Ω): Limits current to the gate of the SCR for safe triggering.

### Trigger Circuit

- Q1 (Transistor - 100A/A gain): Senses the battery voltage level and controls the gate triggering of the SCR.
- D1, D2, D4 (Diodes): Ensure proper direction of current, protection, and signal rectification for the gate and transistor circuits.
- R1 (330Ω): Base resistor for Q1 to control base current.
- R4, R5 (820Ω, 100Ω potentiometer): Used as voltage dividers to detect battery voltage and adjust charging cut-off level.
- R6 (100Ω): Helps stabilize the voltage sensing circuit.

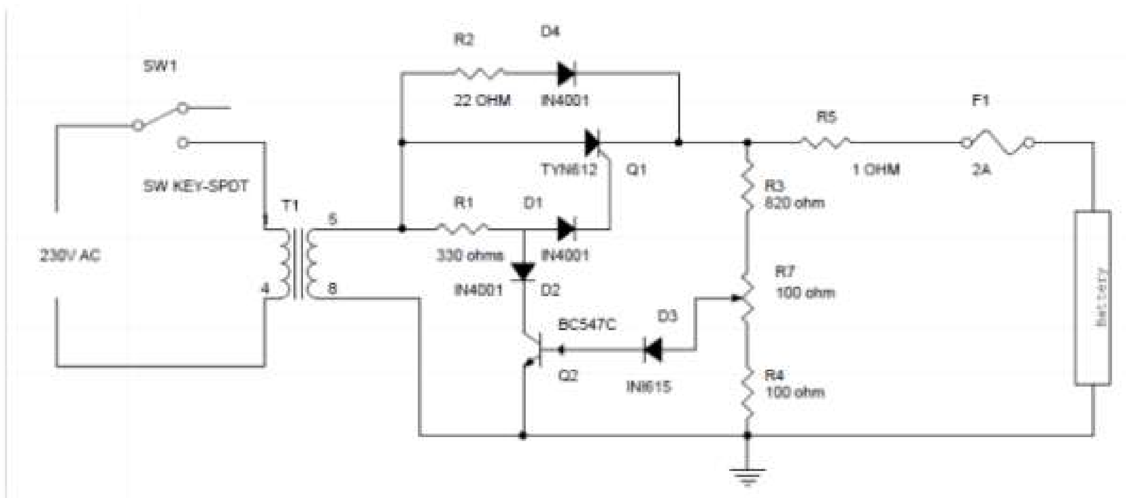
### Battery and Load Section

- U1 (2A inductor): Filters current to the battery, reducing ripple.
- PR1 (Battery/Load): Connected battery (12V) for charging.
- V2 (12V Battery): Target battery to be charged.

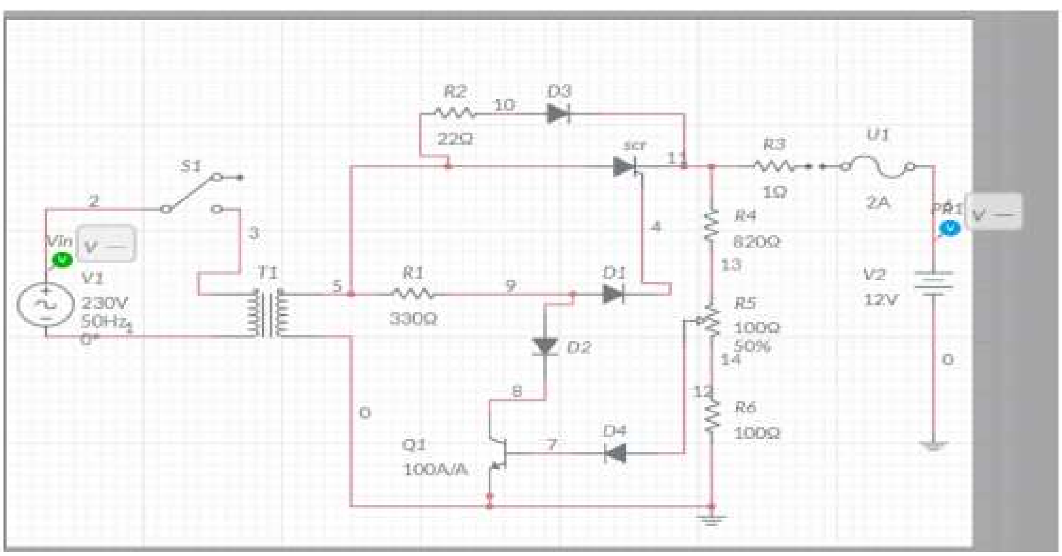
### Working Overview

When the battery is undercharged, the transistor Q1 is OFF, allowing the SCR to trigger and conduct, supplying current to the battery. As the battery charges, the voltage at the base of Q1 increases. Once it reaches a threshold, Q1 turns ON, pulling the gate of the SCR low and turning it OFF—thus stopping the charge.

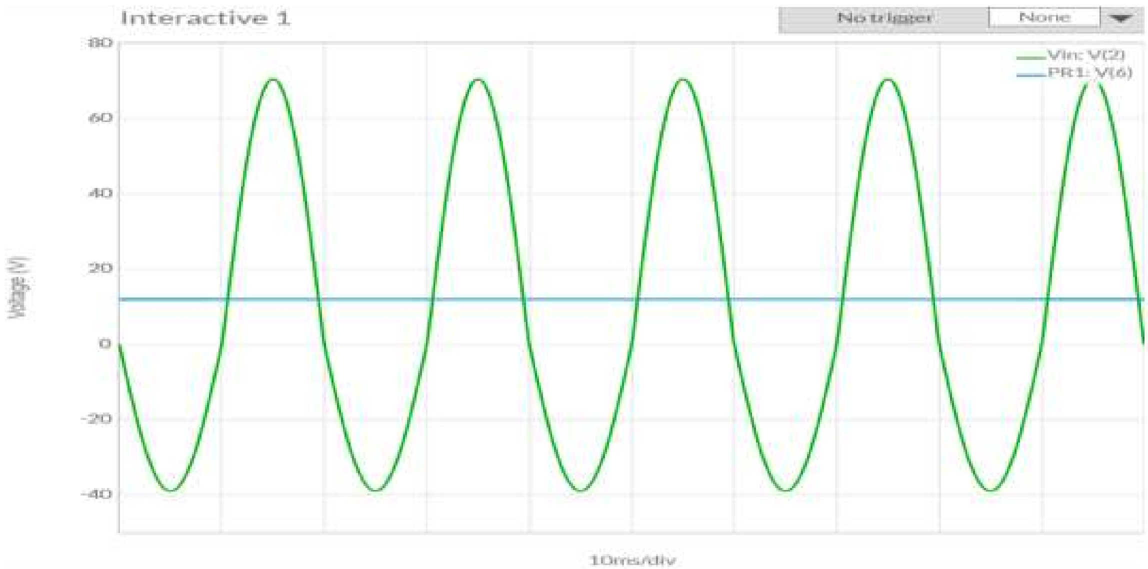
## 5. Circuit diagram




## 6.Simulation



## Output:-




Blue line indicates the output (5V)

## 7.Algorithm

- **Start**
- **Initialize Components**:
  - Apply AC input (230V, 50Hz) to the transformer.
  - Ensure switch `S1` is closed to allow power to the circuit.
- **Step-down AC Voltage**:
  - The transformer steps down the AC voltage to a lower level suitable for charging (e.g., 15–18V AC).
- **Rectification**:

- The rectifier diodes convert the AC voltage from the transformer to pulsating DC.

- **Trigger SCR**:
  - A control signal is generated through the voltage divider network (R4, R5, R6) and applied to the gate of the SCR.
  - The SCR (Silicon-Controlled Rectifier) remains off until the gate receives a triggering pulse.

- **Charging the Battery**:
  - When the SCR is triggered, it conducts and allows current to flow to the battery through the load (R3 and U1 – the battery).
  - Diodes D3 and D4 ensure unidirectional current and prevent reverse current flow.

- **Overcharge Detection**:
  - A voltage sensing circuit monitors the battery voltage.
  - Once the battery voltage reaches the preset threshold (e.g., 12V), a signal is sent to the control transistor Q1.

- **Control Action**:
  - Q1 conducts and pulls down the gate current of the SCR.
  - SCR turns off, stopping the charging process.

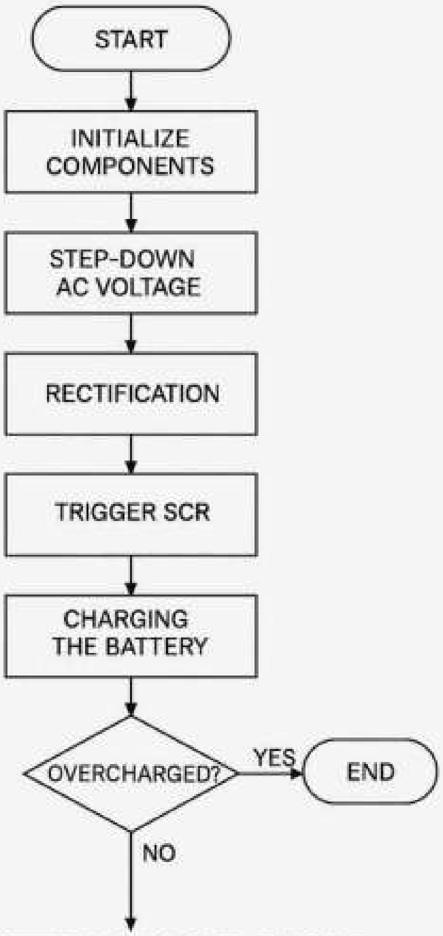
- **Wait or Restart**:
  - If battery voltage drops below the threshold again, the SCR is triggered once more for charging.

- **Repeat or End**:

- Continue monitoring and controlling as needed.
- Stop the process if switch `S1` is opened or power is removed.

- **End**

## Flowchart:




SCR BATTERY CHARGER CIRCUIT ALGORITHM

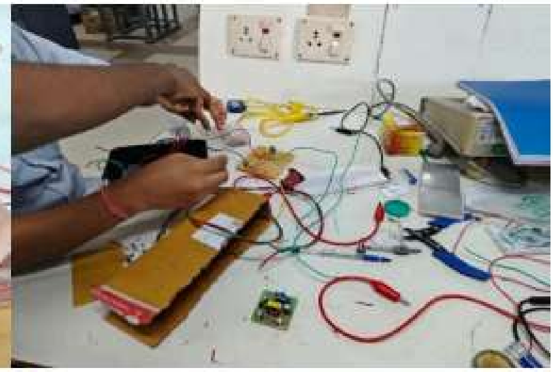
## 8.Program

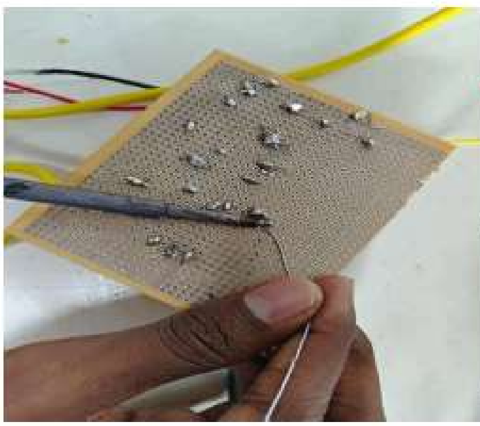
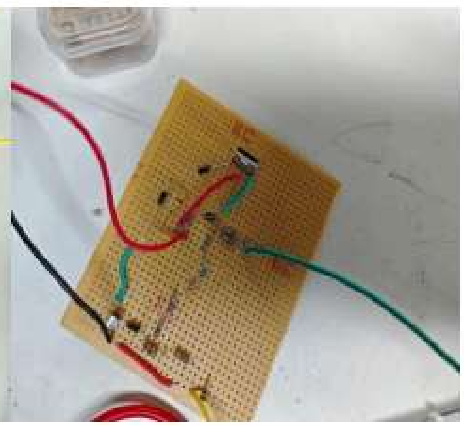
```
#include <stdio.h>

#include <stdbool.h>
```

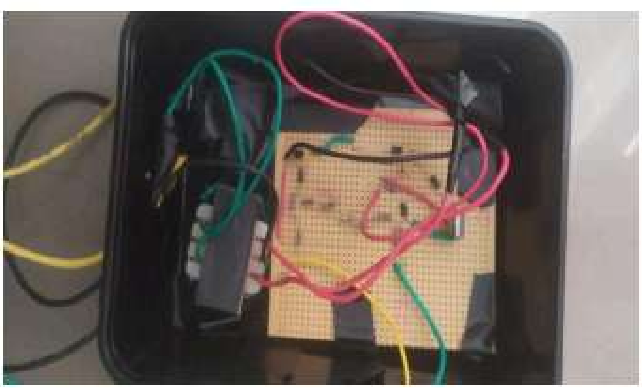
```
// Simulated battery voltage and threshold
float batteryVoltage = 10.5;
const float FULL_CHARGE = 12.0;

// Simulated SCR state
bool SCR_ON = false;

// Function to simulate SCR triggering
void triggerSCR() {
    SCR_ON = true;
    printf("SCR Triggered: Charging Started.\n");
}

// Function to simulate turning off SCR
void turnOffSCR() {
    SCR_ON = false;
    printf("SCR Turned Off: Charging Stopped (Battery Full).\n");
}

// Function to simulate battery charging process
void simulateCharging() {
    while (batteryVoltage < FULL_CHARGE + 0.2) {  // +0.2 for hysteresis
simulation
```

```
        if (batteryVoltage < FULL_CHARGE) {
            if (!SCR_ON) {
                triggerSCR();
            }
            batteryVoltage += 0.1;  // Simulate voltage rise during charging
            printf("Charging... Battery Voltage: %.2fV\n", batteryVoltage);
        } else {
            if (SCR_ON) {
                turnOffSCR();
            }
            printf("Battery Fully Charged: %.2fV\n", batteryVoltage);
            break;
        }
    }
}

int main() {
    printf("Starting Mobile Charger Simulation Using SCR...\n");
    simulateCharging();
    return 0;
}
```

# 9.Hardware Developed







## 10.Conclusion

The project on *Mobile Charging Using SCR (Silicon Controlled Rectifier)* successfully demonstrates the controlled charging of a mobile battery using simple power electronics principles. The SCR acts as an effective switch that regulates the charging process, ensuring that the battery receives a steady and controlled DC voltage.

Through this project, we achieved:

- Safe conversion of AC to DC using a step-down transformer and rectifier.
- Controlled power delivery to the load (mobile battery) using SCR.
- Protection against overcurrent and reverse polarity using appropriate circuit components.

This system provides a cost-effective, reliable, and efficient solution for mobile charging applications. The use of SCR allows precise control and automation potential for future enhancements such as auto cut-off and digital monitoring. The project also offers a valuable learning experience in the practical application of semiconductors in power control systems.

## 11.Reference


❖ https://www.electronicshub.org/battery-charger-circuit-using-scr/
❖ https://www.eleccircuit.org/battery-charger-circuit-using-scr
❖ https://ww.electronicscomp.com/
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