

TECHNOCOGNITION '25



Inter-College 36-Hour International Level Protothon

Project Title : SunSync: Dynamic Solar Energy Storage and Transfer Unit for Electric Vehicles
“Charge Anywhere. Move Everywhere. Powered by the Sun.”

Team Syncronauts – “Synchronizing Light and Motion”

Team Members :

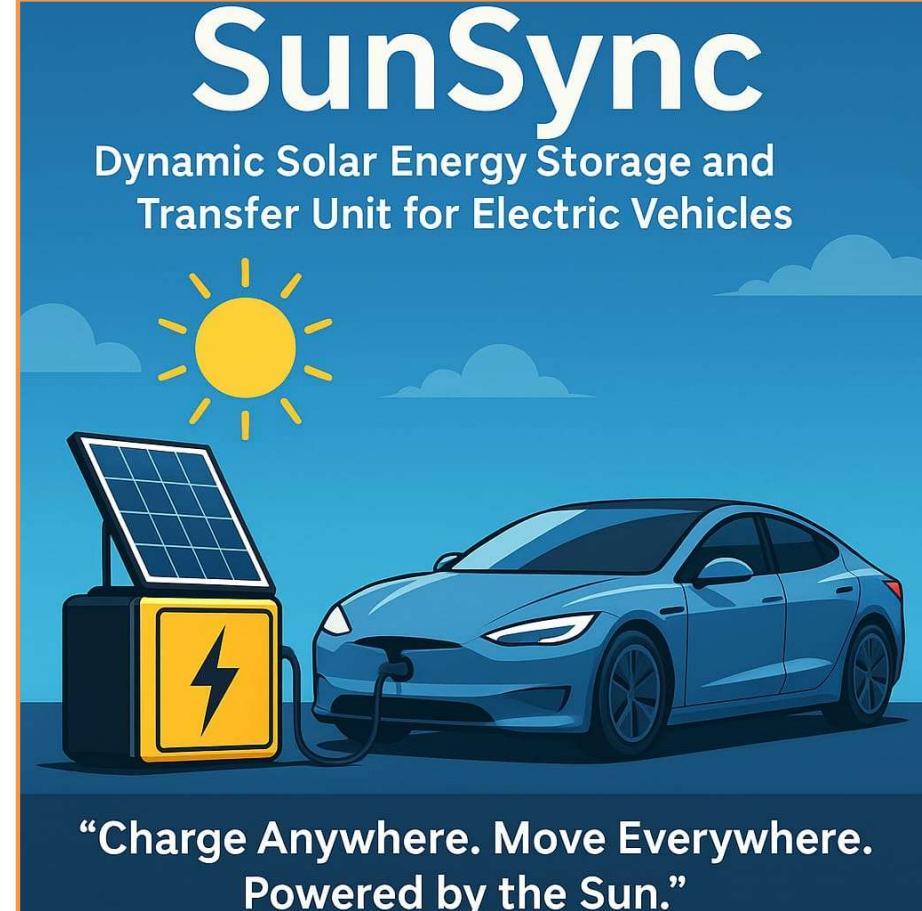
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Theme : Circuit Minds

PROBLEM STATEMENT

Problem Statement :

- EV adoption is rising, but rural/off-grid regions still lack reliable charging infrastructure, causing range anxiety.
- Current charging depends on stationary, grid-based power — limiting mobility and access during outages or disasters.
- Solar energy is abundant, yet present systems are fixed, non-portable, and not integrated with EVs
- Setting up permanent charging stations is costly, time-consuming, and restricted by location
- Industries, military, and remote field teams still rely on diesel generators, reducing sustainability.
- Existing solar solutions are passive and lack intelligent, real-time optimization for energy use.



SunSync
Dynamic Solar Energy Storage and Transfer Unit for Electric Vehicles

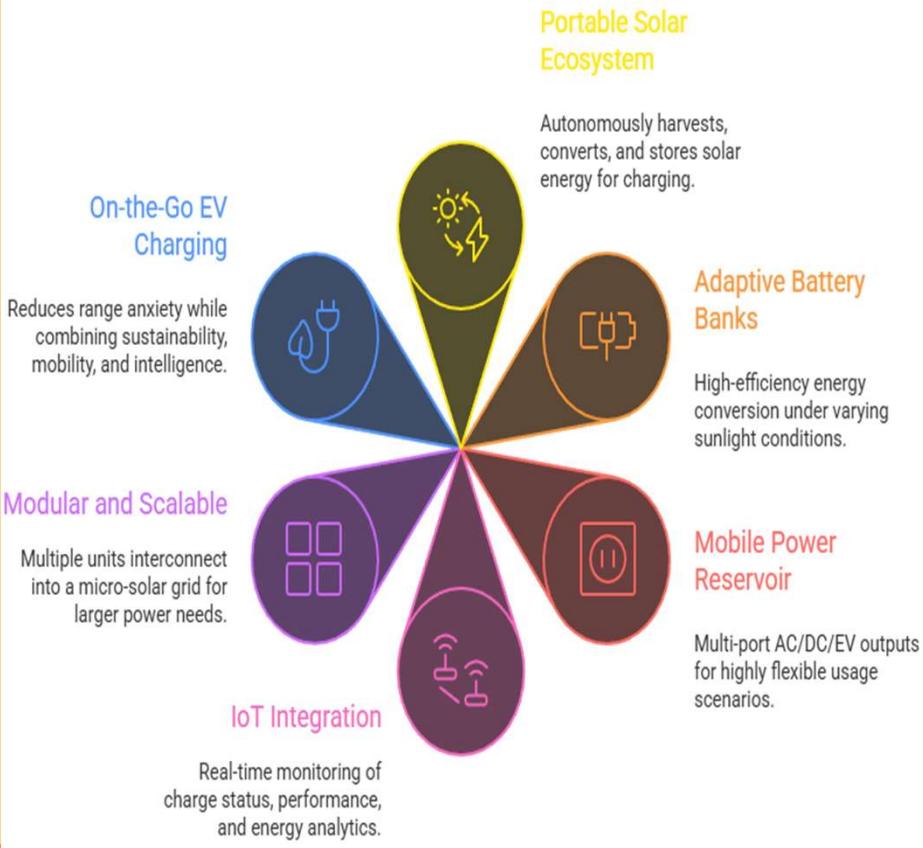
A blue electric car is shown connected to a portable solar charging unit. The unit has a solar panel on top and a yellow front panel with a lightning bolt symbol. The background features a bright sun and a blue sky with clouds.

“Charge Anywhere. Move Everywhere.
Powered by the Sun.”



SOLUTION OVERVIEW

Solution Overview :



The Growing Need for Portable Renewable Energy Solutions

- Limited EV charging infrastructure in rural and offgrid regions
- Solar energy systems are often stationary and inefficient for mobile use
- EVs depend entirely on static charging points, reducing travel flexibility
- Emergency and disaster zones lack renewable, portable power

"How can we make solar power mobile, self-sustaining, and reliable enough to support electric mobility anywhere?"

SunSync The All-in-One Solution

A portable solar energy storage and transfer unit for EVs

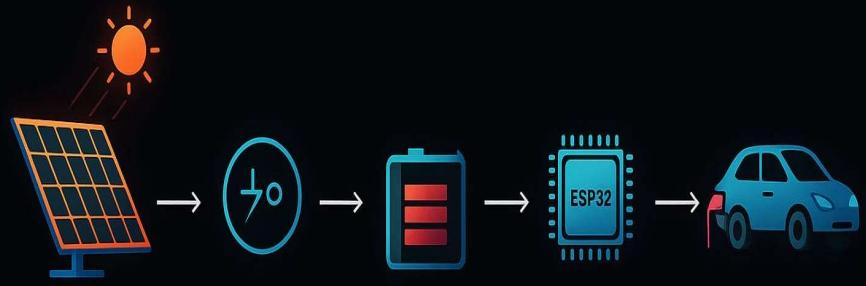
- Utilizes solar panels to charge an integrated battery unit
- Stores and releases power dynamically based on EV needs
- Portable and self-sustaining: designed for use in remote areas and emergencies

Enables EV charging without reliance on grid-based infrastructure

Problem statement: "How can make solar power mobile, self-sustaining, and reliable enough to support electric mobility anywhere?"

IMPLEMENTATION/PROTOTYPE

SUNSYNC PROTOTYPE ARCHITECTURE



INPUT
Flexible Solar Panel Array with Dual-Axis Tracking

POWER REGULATION
MPPT Circuit for Efficient Conversion

ENERGY STORAGE
High-Density Lithium-Ion Battery Bank with Smart BMS

CONTROL UNIT
ESP32 Microcontroller for Monitoring, Control, and IoT Connectivity

OUTPUT
EV Charging Port + AC/DC Multi-Output Interface

WORKING PRINCIPLE

SOLAR → MPPT → CONTROLLER → BMS → POWER CONVERTER → EV LOAD

System Architecture :

High-efficiency solar panels with dual-axis tracking
Maximum energy capture



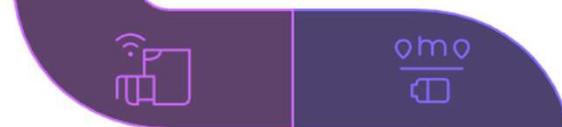
Advanced MPPT regulation stage

ESP32-based control unit
Real-time system monitoring



Efficient energy conversion

Real-time data transmission via WiFi
IoT visibility



Smart Li-ion battery bank with BMS protection

Compact, mobile prototype with retractable panels
Full power flow demonstration



Energy storage and safety

DC 48V EV charging plus AC/DC converters

Multi-device compatibility

Robust protection safeguards

System safety



TECHNOLOGY STACK

Technologies Used :

Hardware

Solar panels, MPPT controller, battery pack, ESP32, converters, sensors, and OLED display.

Software & Tools

Arduino IDE, MATLAB, KICAD/Proteus, and Blynk for firmware, optimization, design, and IoT UI.

Sensors & Monitoring

Voltage, current, temperature, irradiance, and fault detection for system feedback.

Connectivity

Wi-Fi/Bluetooth for cloud sync, remote monitoring, and smart control.

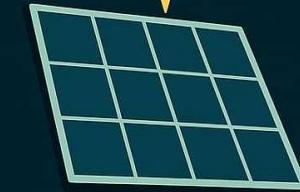
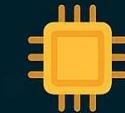
Algorithms & Analytics

MPPT + power routing optimization, real-time SoC tracking, performance insights.

Closed-Loop Operation

Continuous optimization from solar capture to power delivery.

TECH STACK



Microcontroller
Sensors

Battery Management

AI Algorithms



IMPACT & SCALABILITY

Impact & Scalability :

Environmental Benefits

Reduces fossil fuel dependency and promotes clean energy.

Electric Mobility
Enhances EV range and charging reliability.

Industrial and Military Support

Powers critical operations for industrial and military sites.



Disaster Response

Provides rapid power for emergency situations.

Rural Electrification

Supports power needs in remote and rural areas.

Scalability and Cost-Efficiency

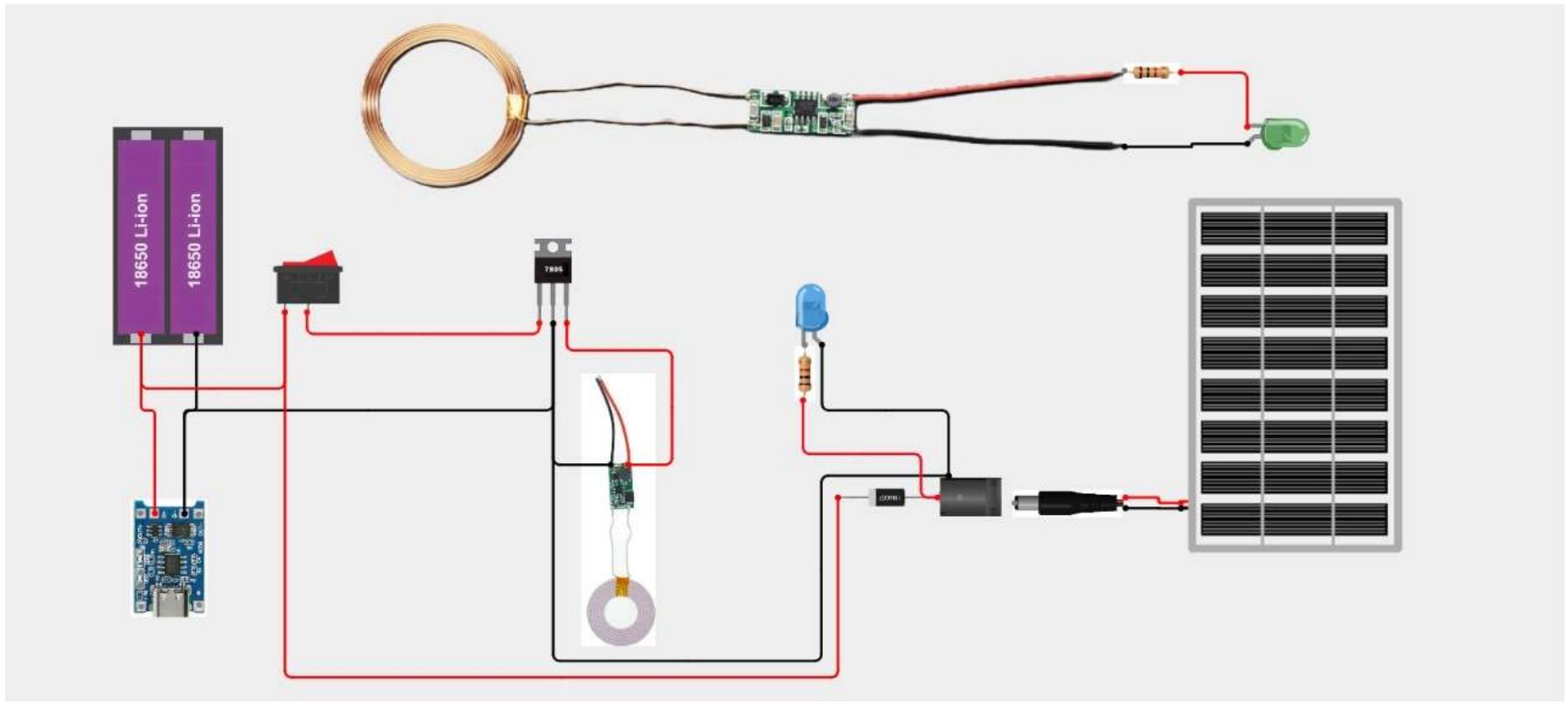
Allows for modular expansion and AI-driven optimization.

IMPACT

- Renewable Charging
- Energy Resilience
- Grid Independence
- Cost Savings



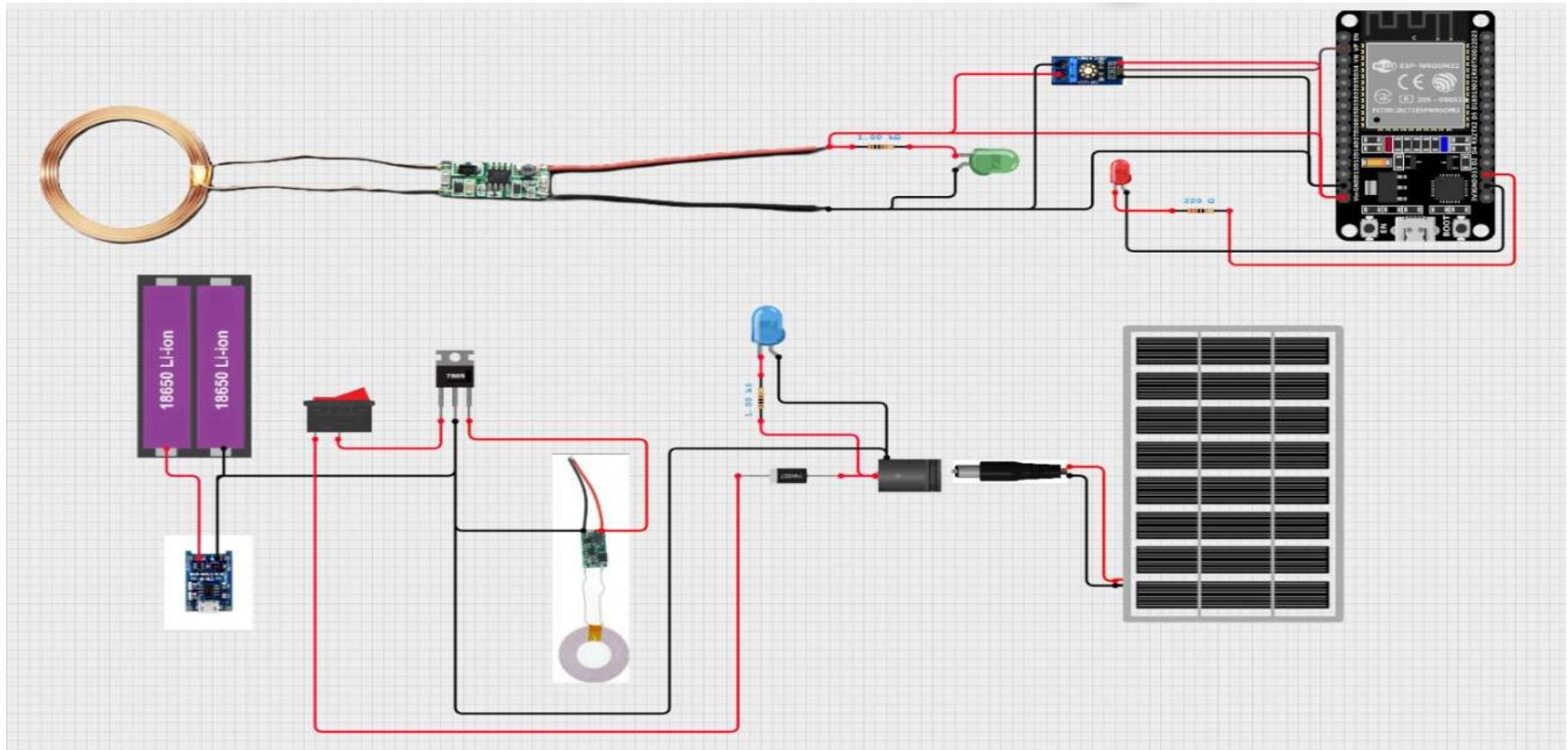
Prototype(1)



Prototype 1 – Basic Circuit Description :

Prototype 1 represents the fundamental charging and power-management system of our SunSync project. It includes a pair of 18650 Li-ion batteries charged through a TP4056 module, supported by a solar panel input with a diode for reverse-current protection. A wireless power transmitter and receiver pair is used to demonstrate inductive energy transfer. The received power is regulated using a 7805 voltage regulator, and LED indicators are added to show charging activity and power status. This basic prototype validates the core functions of energy intake, wireless transfer, regulated output, and battery charging—forming the foundational stage for the advanced ESP32-based monitoring system in the next prototype.

Prototype(2)



Prototype 2 – Developed Model Description :

Prototype 2 represents the advanced version of the SunSync system, integrating smart monitoring and wireless charging into a unified setup. This prototype includes a complete wireless power transfer path, where the transmitter delivers energy to the receiver coil, which then powers both the ESP32 microcontroller and the battery charging system. A voltage sensor is added to continuously measure the battery level, enabling the ESP32 to intelligently detect when the battery reaches full charge. LED indicators provide immediate visual feedback, while the microcontroller allows for expansion into automated notifications and smart energy management. Solar input is retained for supplementary charging, regulated through the diode and TP4056 charger module. Overall, Prototype 2 validates the seamless combination of wireless charging, solar support, regulated output, and microcontroller-based monitoring—marking a major step toward a fully autonomous EV charging unit.



RESULTS/FUTURE SCOPE

Results/Future Scope :

Future Upgrades

Future upgrades include AI and wireless charging.



IoT Integration

IoT integration enables real-time performance insights.



Conversion Efficiency

Up to 90% conversion efficiency achieved.



Long-Term Vision

Long-term vision targets national grid sync.



Scalability

Scalable design for rural and urban deployment.

Load Compatibility

Successfully tested for 24V/48V loads.



SunSync

REVOLUTIONIZING PORTABLE SOLAR ENERGY

SUSTAINABLE

INTELLIGENT

MOBILE

SCALABLE



Charge Anywhere. Move Everywhere.
Powered by the Sun.

THANK YOU

Presented by Team [Your Team Name]

Department of ECE, Dayananda Sagar University