# IOT Smart Energy Grid

## Abstract:

The IoT Smart Energy Grid system is designed to enhance the reliability and efficiency of power distribution using IoT technology. Traditional energy grids often face failures, resulting in blackouts and service interruptions. This project leverages the ATmega328P microcontroller and ESP8266 Wi-Fi module to monitor energy grids in real-time and ensure uninterrupted power supply by automatically switching to an alternative grid during failures. It also keeps track of power consumption, estimated cost, and detects power theft, updating all data on the IoTGecko platform.

## Aim:

To develop an IoT-based Smart Energy Grid system that ensures continuous electricity supply, monitors power usage, and detects electricity theft in real-time.

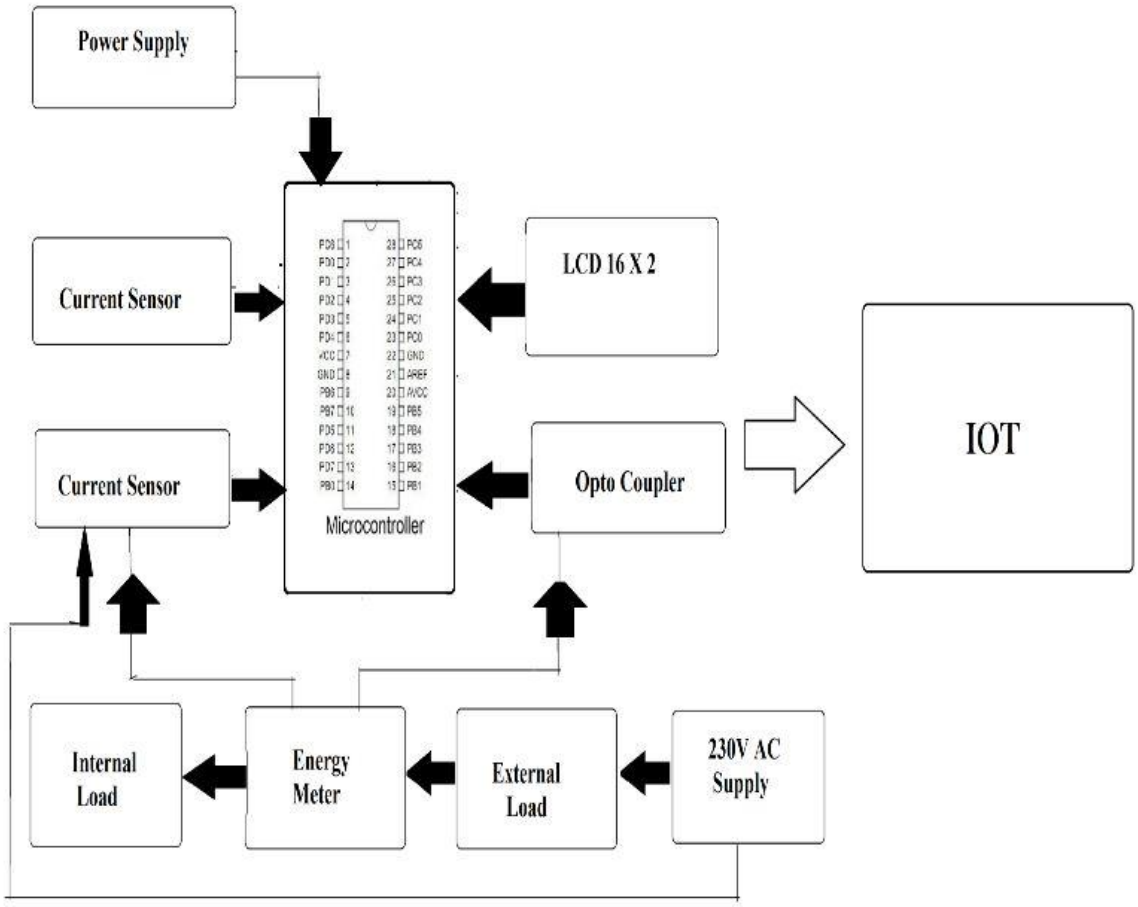
## Objectives (Short & Precise):

- To monitor the status of energy grids and switch to active ones during grid failures.
- To track energy consumption and calculate cost in real-time.
- To detect and notify about electricity theft using sensor input.
- To update all data and alerts to the IoTGecko webpage for monitoring.
- To provide a reliable and scalable solution for smart power distribution.

## Working:

The system uses an ATmega328P microcontroller connected to energy meters, current sensors, and ESP8266 for internet communication. It simulates a consumer setup with one valid and one invalid consumer (represented by bulbs). In case of a grid failure, the system automatically shifts power to a working grid to maintain uninterrupted supply. Energy usage and theft detection are monitored, and all related data (cost, usage, theft alert, active grid) is uploaded to the IoTGecko portal for remote access by authorities.

## Block Diagram:




## Hardware Components:

- ATmega328P AVR Microcontroller
- ESP8266 Wi-Fi Module
- Optocoupler
- Energy Meter
- Current Sensor
- LCD Displays
- Push Buttons
- LEDs, Resistors, Capacitors, Diodes
- Transistors
- Crystal Oscillator

- PCB, Cables, Connectors
- Transformer / Adapter
- Load (Lamps)

## Software Components:

- IoTGecko (Web Interface)
- Arduino IDE / Compiler
- Programming Language: Embedded C

## Advantages:

- Ensures continuous power supply with automatic grid switching
- Real-time monitoring of power usage and theft detection
- Remote access to all data via IoT platform
- Scalable to multiple grids and locations
- Reduces manual intervention and maintenance costs

## Disadvantages:

- Requires constant internet connection for real-time updates
- Initial setup cost may be high
- Dependent on electronic components that may fail under harsh conditions

## Applications:

- Smart cities and industrial zones
- Remote or rural electrification systems
- Energy monitoring for residential buildings
- Power theft prevention in distribution systems
- Utility companies for real-time grid diagnostics

## Future Scope:

- Integration with AI to predict grid failure and optimize load distribution
- Mobile app support for users and administrators
- Renewable energy source integration (solar/wind grid switching)
- Blockchain-based secure energy transactions and logs
- Smart billing and predictive maintenance alerts

## Conclusion:

The IoT Smart Energy Grid is an innovative solution to modern power distribution challenges. By enabling real-time monitoring, auto-grid switching, and theft detection, it ensures reliability and accountability in electricity supply systems. This system holds great potential for large-scale deployment in smart infrastructure projects and offers a promising step toward intelligent energy management.