IOT-BASED ELECTRICITY ENERGY METER USING ESP32 AND THINGSPEAK

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PROBLEM STATEMENT

Traditional energy meters only display total consumption, and there's no way to track real-time usage. This limits user control and makes it harder to manage electricity bills. Manual readings are also time-consuming and can lead to errors. While smart meters do exist, they're often expensive and not accessible to everyone. So, we wanted to create an affordable alternative that offers live monitoring remotely.

INTRODUCTION

- Electricity consumption is rising, making efficient usage crucial.
- Traditional meters offer no real-time usage insight.
- Consumers are often unaware of their usage patterns.
- Growing demand for smart, accessible, and real-time monitoring systems.
- Our solution addresses these needs using IoT technology.

OBJECTIVES

- Develop a low-cost energy meter using ESP32 and sensors.
- Track voltage, current, and power in real time.
- Calculate energy consumption (kWh) dynamically.
- Stores data on cloud
- Encourage users to monitor and reduce power consumption.

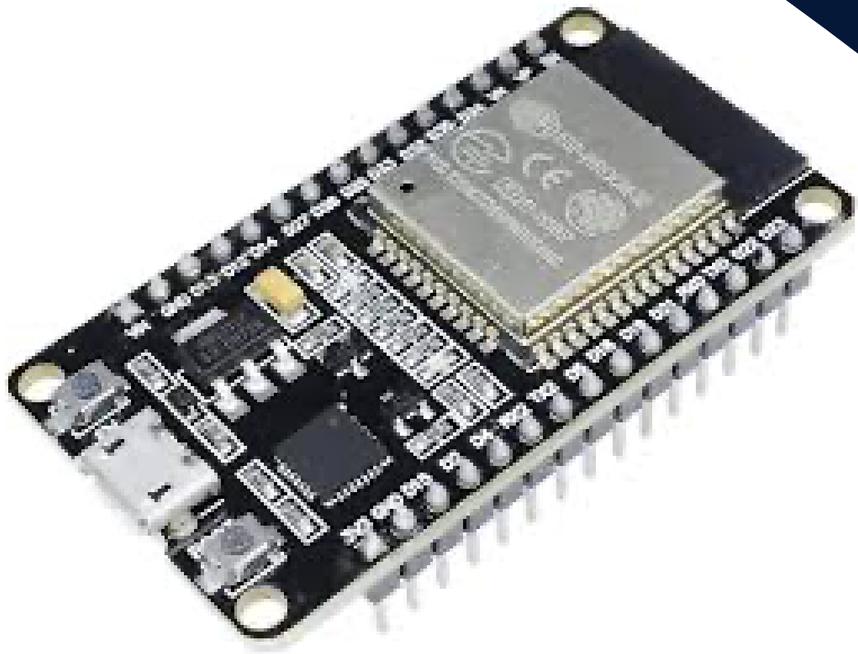
EXISTING SYSTEM VS PROPOSED SYSTEM

Existing System	Proposed IoT System
Manual reading	Real-time updates
Old-style meters that show only total usage	DIY and low-cost smart energy meter with ESP32.
Smart meters with limited accessibility and high cost.	Live data tracking on voltage, current, power, and energy.
No remote access	Remote access

SYSTEM ARCHITECTURE

1. ESP32

ESP32 is used because it has built-in Wi-Fi and high processing power, making it ideal for real-time data monitoring and wireless transmission



SYSTEM ARCHITECTURE

2. SCT-013 Current Sensor

It is used to measure AC current non-invasively by clamping around a wire. It provides an analog output proportional to the current, which is read by the ESP32.

SYSTEM ARCHITECTURE

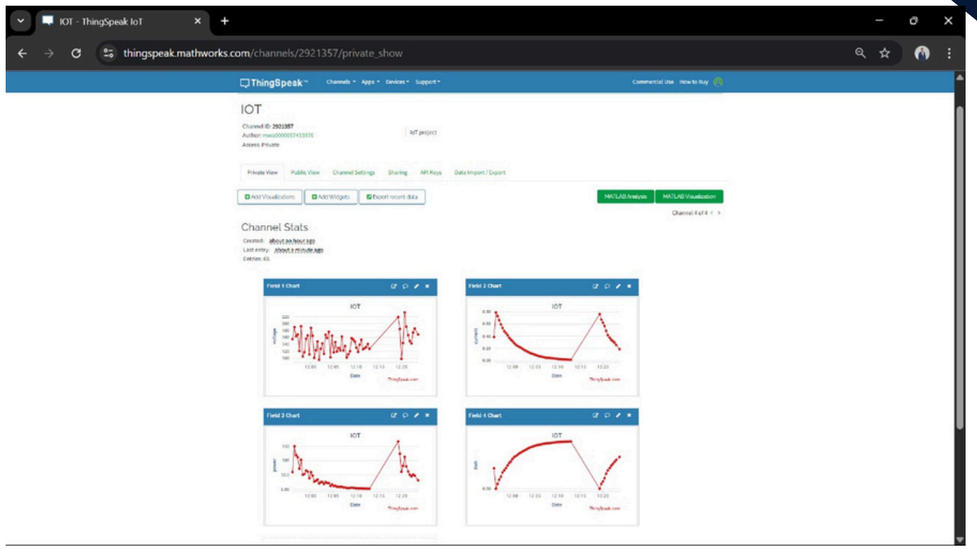
3. ZMPT101B Voltage Sensor

It is used to measure AC voltage in electrical circuits and provide a proportional output voltage for monitoring.

SYSTEM ARCHITECTURE

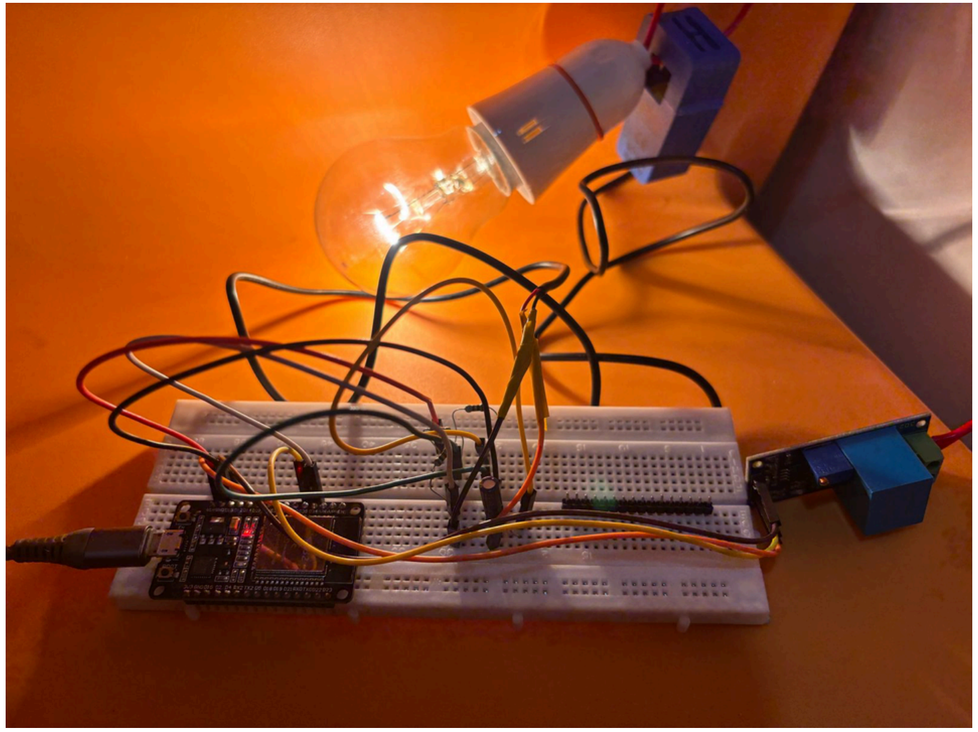
5. ThingSpeak

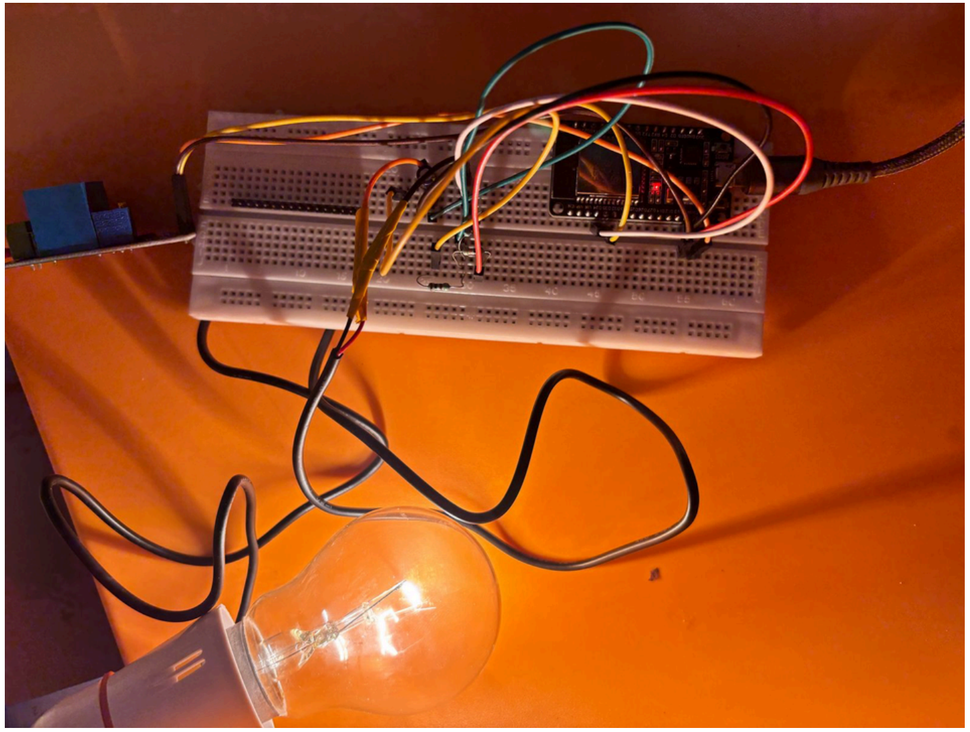
ThingSpeak is used to send real-time energy data from the ESP32 to the cloud. It displays live graphs of voltage, current, and power, and lets users monitor usage remotely from their phone or computer.



IMPLEMENTATION SNAPSHOTS

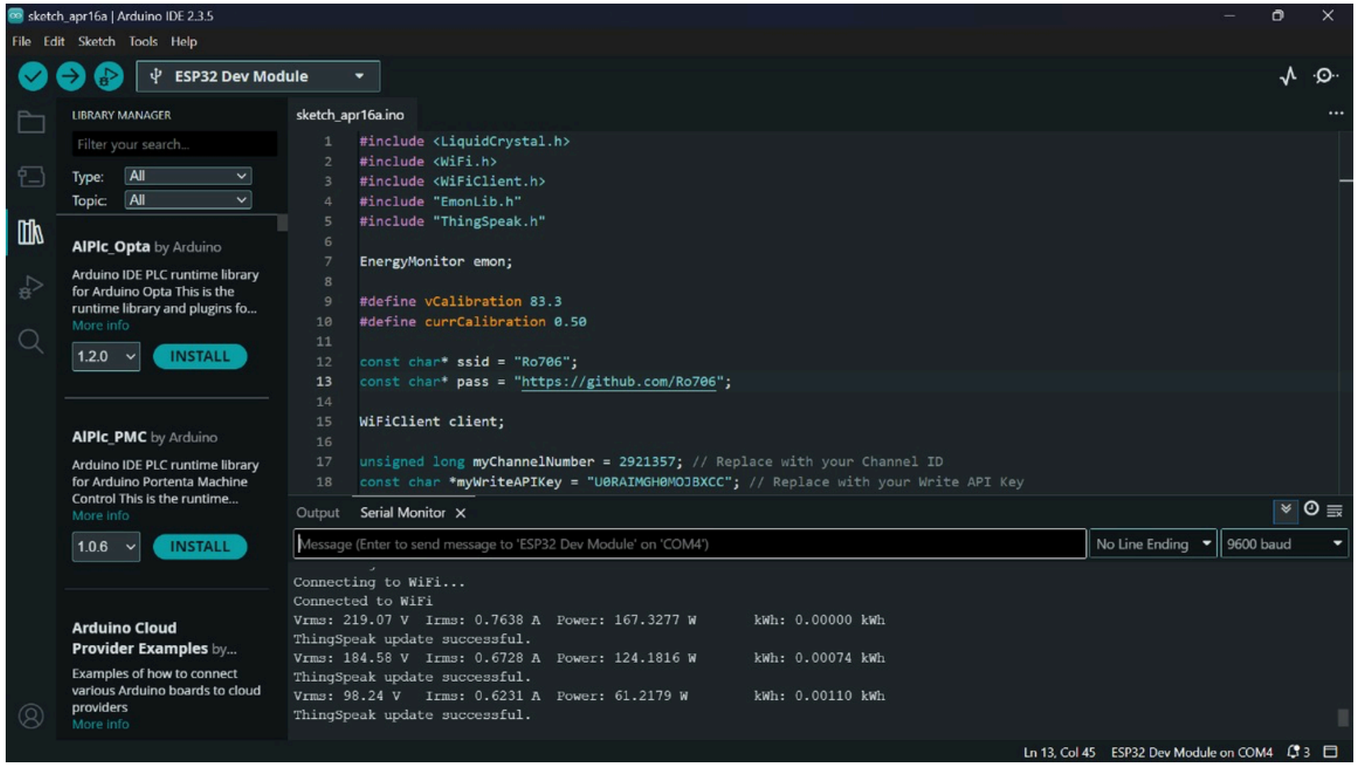
Hardware setup

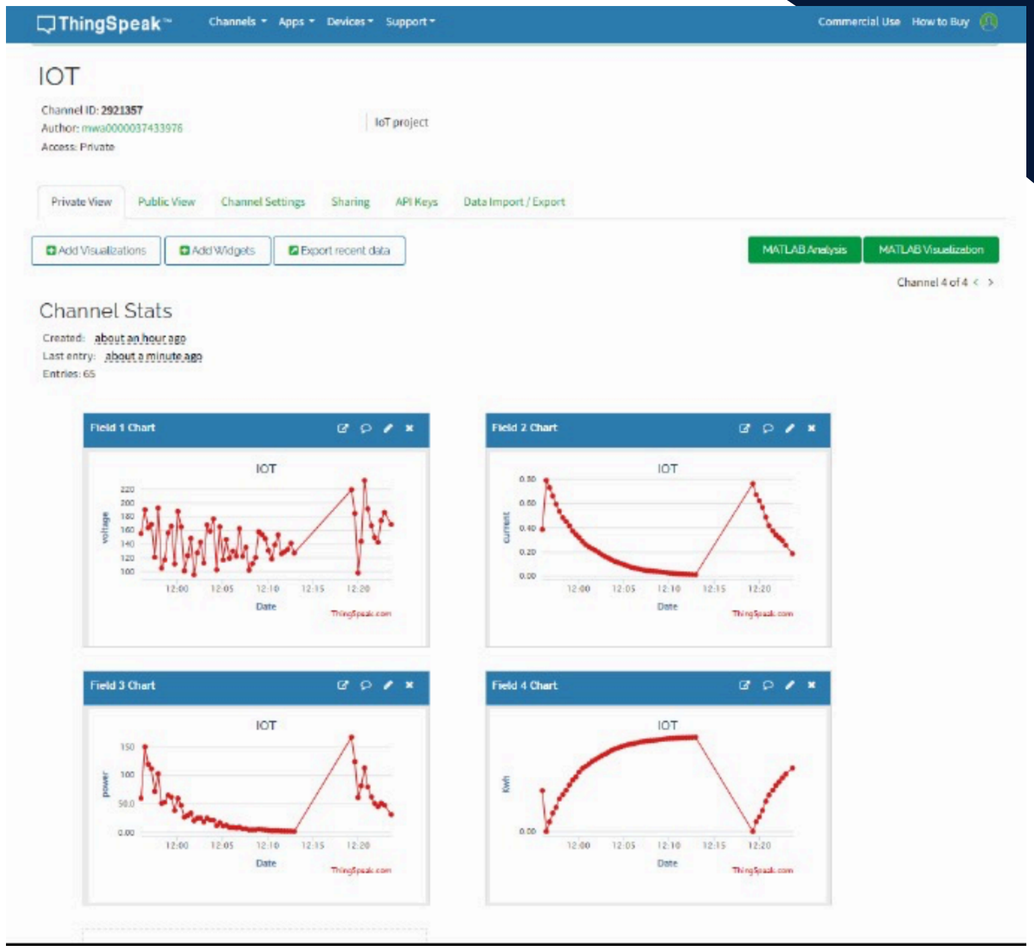




IMPLEMENTATION SNAPSHOTS

Software setup





WORKING PRINCIPLE

- AC voltage and current are sensed through their respective sensors.
- ESP32 reads analog values and uses EmonLib for calculation.
- Energy (kWh) is computed based on apparent power and time.
- Data is uploaded to ThingSpeak in real time.
- System updates periodically and continues tracking over time.

FUTURE SCOPE

- Build a dedicated mobile app for all local users to access and track their individual meter readings.
- Include features like customized alarms, usage warnings, and energy-saving suggestions.
- Integrate voice assistant support (Alexa/Siri) for live usage queries.
- Enable cost estimation based on regional tariff rates.
- Expand into smart load management and predictive analytics for better energy control.

CONCLUSION

The project successfully developed a real-time, IoT-based energy monitoring system using ESP32 and ThingSpeak. It enables accurate, remote, and local tracking of electricity usage, promoting energy awareness and efficiency. With its scalable design, it lays a strong foundation for future smart grid innovations.

THANK YOU