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# **IOT-BASED SMART ENERGY METER**

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#### ABSTRACT:

Electricity usage keeps going up everywhere, and tracking it properly has become a real need. In this project, we tried making a Smart Energy Meter using some basic IoT stuff. It helps check electricity usage live, sends alerts, and even tries to catch theft if anything odd happens. We used simple parts like an ESP8266 board and a few sensors. All the data gets pushed to the Blynk app through Wi-Fi. When something unusual shows up, it quickly alerts the user. The main goal was just to make energy meters smarter without making them expensive or complicated.

## 1. Introduction

Old-style energy meters are kinda outdated now because they need someone to go and take readings manually. This not only wastes time but mistakes can also happen easily. Plus, in a lot of places, electricity theft is still a real problem.

We thought of making something better with IoT. Our Smart Energy Meter keeps checking the power use every second and updates it live. Also, if something weird like sudden usage drops or spikes happens, it can alert people immediately. We mainly used ESP8266, some sensors, and the Blynk app to make everything simple and accessible through a mobile phone.

### 2. Objectives

Here's what we planned to achieve:

- Make an affordable smart energy meter.
- Allow people to see live electricity usage from their phones.
- Make billing automatic to avoid manual mistakes.
- Send quick alerts when something unusual happens.
- Help people use electricity more carefully once they see live data.

## 3. Scope and Uniqueness

Compared to old meters, our system does a lot more:

- It shows live readings through a mobile app.
- You can control appliances remotely too.
- You can track usage history and find patterns.
- It can catch strange behavior like theft or tampering.
- Alerts are sent instantly for high usage.

The best part is that it's cheap and doesn't need fancy smart grids. Anyone can set it up easily at home, schools, or small offices.

#### 4. Literature Review

Earlier projects mostly tried similar things but missed a few points. Smith and Brown (2021) made a Wi-Fi logger but didn't have theft alerts. Kumar and Sharma (2022) worked on SMS alerts but didn't use cloud apps or live graphs.

We tried to improve all that by combining theft detection, live tracking, and mobile alerts using Blynk. Also, making it simple enough that even non-technical users can manage it.

## 5. Methodology

#### 5.1 System Architecture

#### We used:

- ESP8266 NodeMCU: To manage Wi-Fi and process sensor data.
- Current Sensor (SCT-013): To check the current flowing.
- Voltage Sensor: To calculate full power.
- Relay Module: To switch devices remotely.
- Blynk App: For showing all readings live.

#### 5.2 How It Works

First, sensors measure the electricity. Then ESP8266 sends this info to the Blynk app over Wi-Fi. Users can open the app anytime and see live graphs. If the system finds strange behavior (like zero current but still voltage), it sends an alert. Billing is also done based on the recorded data.

#### 6. Hardware and Software Used

Component	Purpose
ESP8266 NodeMCU	Main controller and Wi-Fi module
SCT-013 Current Sensor	Measures current safely
Relay Module	Remote switching of devices
Voltage Divider	Adjusts voltage levels safely
BlynkIoT App	Mobile dashboard for data and control
Arduino IDE	Writing and uploading the code

## 7. Results

During testing, the system worked like we hoped most of the time:

- Energy usage showed up live on the app without much delay.
- Alerts came through whenever the load crossed set limits.
- Remote ON/OFF control of appliances worked fine.
- Theft detection also worked when we disconnected a wire, it caught it.
- Billing numbers were close to actual usage.

One thing we noticed was that if Wi-Fi dropped even for a few seconds, the system lagged a bit, but it usually recovered quickly.

## 8. Conclusion and Future Plans

So in short, the Smart Energy Meter we made using IoT ideas actually worked. It monitored usage, generated bills, and sent theft alerts too. It could really help people keep an eye on their electricity and stop wasting energy.

If we keep working on it, we could:

- Connect it to solar panels too.
- Use AI to guess future electricity needs.
- Add more security to stop hackers.
- Use blockchain to make billing super transparent.

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