IoT-Based Energy Usage Tracker for Appliances

**Objective**

To monitor and log the **power consumption** (voltage, current, power, energy usage) of home or industrial appliances in real-time, and display it on a **dashboard/app** using ESP32 and a current/voltage sensor.

**Components Required**

| **Component** | **Purpose** |
| --- | --- |
| ESP32 / ESP8266 | Wi-Fi-enabled microcontroller |
| **PZEM-004T** OR **INA219** | Voltage & current monitoring |
| AC Load (Bulb, Fan) | Appliance to be monitored |
| Blynk / Firebase / ThingSpeak | IoT dashboard |
| Relay Module (optional) | For remote ON/OFF control |

**Recommended Sensor: PZEM-004T**

It can measure:

* Voltage (AC)
* Current
* Power (W)
* Energy Consumption (kWh)
* Frequency

It communicates via **UART (TX/RX)** with ESP32.

**Circuit Connections (PZEM-004T + ESP32)**

| **PZEM-004T** | **ESP32** |
| --- | --- |
| VCC | 5V |
| GND | GND |
| TX | GPIO16 (RX2) |
| RX | GPIO17 (TX2) |

Use a **220V bulb** or fan as a load connected via PZEM’s CT clamp and voltage input.

**Dashboard Setup**

* Use **Blynk** or **ThingSpeak**
* Display:
  + Voltage (V1)
  + Current (V2)
  + Power (V3)
  + Energy Used (V4)
  + Optional: Power switch (V5)