National Textile University, Faisalabad

Department of Computer Science

Course Name:

Internet of Things Fundamentals

Course Code:

AIE-3079

Submitted To:

Dr. Nasir Mahmood

Submission Date:

May 04, 2025

Group Members:

- *Hasham Ul Haq — 22-NTU-CS-1361*
- *Abdul Wahab __22-NTU-CS-1337*
- *Abdul Qayyum __22-NTU-CS-1335*

Project Title:

IOT-Based Smart Home Energy Monitoring System

Group Name:

Iotrix

Problem Statement and Objectives:

Problem Statement

In most households, there is no clear way to monitor the real-time energy usage of units consumed, leading to inefficient energy consumption and increased electricity bills. A smart Iot-based system that tracks energy usage in real-time and identifies high-consumption devices can help reduce energy waste and enable informed decision-making.

Objectives:

- Build a real-time energy consumption monitoring system for home appliances.
- Use IoT sensors (current sensors SCT-013) to calculate energy usage per device.
- Display energy consumed in kilowatt-hours (kWh) and calculate cost.
- Build a mobile/web dashboard to visualise real-time energy and cost data.
- Optionally integrate AI in the future to detect patterns and give energy-saving suggestions.

Scope of the Project:

In-Scope:

- Monitoring voltage and current using IoT sensors like SCT-013.
- Real-time unit calculation using the formula:
- $\Delta Energy = (P \times \Delta t) / 1000$
- ESP32 microcontroller for data collection and WiFi transmission.
- Blynk/FireBase for dashboard and monitoring.

Out-of-Scope (for now):

- Monitoring energy per appliance or for a group of devices.
- Automatic control of appliances.
- AI-based prediction or anomaly detection (planned for FYP).

Required Hardware:

- ESP32 — WiFi-enabled microcontroller.
- SCT-013 Current Sensor — Measures current consumption.
- Voltage Sensor Module — Optional for more precise power monitoring.
- Breadboard + Jumper Wires — For circuit prototyping.
- Resistors, CT Burden Resistor — For safe signal handling.
- Relay — For future appliance control.
- Power Supply — For ESP32.
- Mobile/PC — For viewing dashboard.

Software, Cloud, Database:

- Arduino IDE — To program ESP32.
- Blynk / ThingSpeak / Firebase — For data monitoring and logging.
- HTML + CSS + JS — If building a custom dashboard.
- Google Sheets — For tracking usage history (optional).

Subjects Used Other than IoT:

- Electrical Engineering — Power measurement principles.
- Web Development — Dashboard design (HTML/JS or Blynk).
- Artificial Intelligence (Future Plan) — Pattern recognition and anomaly detection.
- Cloud Computing — IoT data storage and real-time access. Approach:

Sensor Setup & Testing:

Use SCT-013 sensor to detect current from appliances.

Convert analog signal to readable voltage via burden resistor.

- Energy Calculation:

Measure current (I) and voltage (V) to compute power:

$$P = V \times I$$

Calculate Energy in kWh using:

$$\text{Energy} = (P \times \text{time})/1000$$

Iot Integration:

Program ESP32 to send real-time data via WiFi.

Upload data to Blynk or FireBase.

Visualization:

Create a live dashboard to show:

- Current Power
- Energy Consumed
- Cost in PKR

Send alerts if energy crosses a certain limit.

Testing:

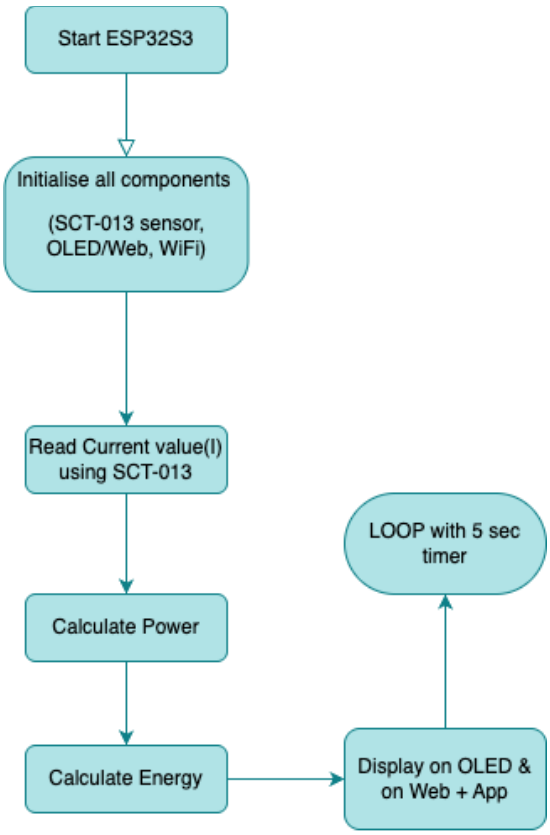
Use different appliances (bulb, fan, iron) to compare consumption.

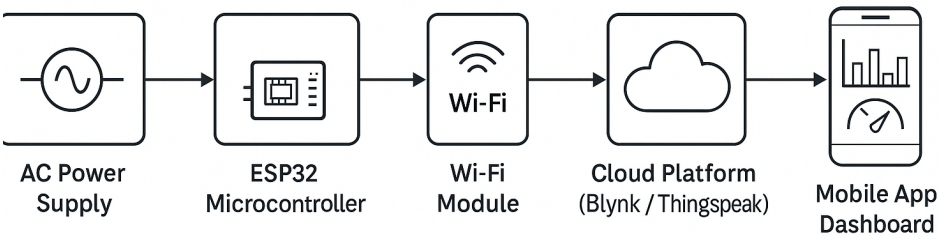
Log usage patterns and match with actual bills.

Deliverables:

- A real-time IoT-based energy monitoring system.
- Live dashboard for viewing power, units, and cost.
- Data logs stored on cloud.
- Final report with system architecture and performance.
- Video demo and working hardware.
- System Architecture (Flow Chart):

System Architecture (Flow Chart):





IoT-Based Home Energingoring System