CSE407 - Midterm Assessment Project Report

Course: CSE407 Green Computing  
Section: 02  
Student ID: [Enter Your ID]  
Student Name: [Enter Your Name]

Project Title: IoT based real-time energy monitoring and dashboard development

# Checklist

✅ Used IoT device (smart plug) to monitor refrigerator energy for 24 hours

✅ Streamlit dashboard built with KPIs, graphs, trendline

✅ Calculated costs, ROI; PESTLE analysis done

✅ All safety, data, UI/UX, compliance issues addressed

✅ Dashboard + code + Excel data ready for demonstration

# Declaration

I declare that the project was done by myself, and the submitted information is free from any unfair means. I complied with all the relevant legal and organizational requirements.

Signature:  
Name: [Enter Your Name]  
Date: 2025-08-02

# Executive Summary

In this project, an IoT-based real-time energy monitoring system was developed to measure and analyze the power consumption of a household refrigerator. Using a smart plug, 24-hour wattage data was recorded. Data was processed using Python, and presented through a Streamlit dashboard that offers real-time energy consumption metrics, visualizations, and cost analytics.  
  
Key highlights include:  
- Real-time and historical usage patterns  
- Daily energy usage (kWh), cost (BDT), trend analysis  
- Financial insights (cost-saving, ROI), safety, and compliance checks  
- PESTLE analysis of the broader implications  
  
The system demonstrates how low-cost IoT can optimize residential energy use, promote awareness, and assist in sustainable energy management.

# Brief Description of the Work

This project captures energy usage data via a smart plug and visualizes it in a Streamlit dashboard. The dashboard offers control (switch ON/OFF via app), real-time wattage, daily kWh, and energy-cost graphs.

Flowchart:  
Planning → Research → Purchase → Configure Device → Data Collection (Excel) → Data Cleaning → Dashboard Development → Deployment

# Detailed Description of Each Step

## 0. Planning

Selected refrigerator for monitoring (continuous load). Planned to use a smart plug with Excel export. Chose Streamlit for dashboard due to Python integration.

## 1. Researching

Explored plug options: TP-Link, Tuya, Sonoff. Focused on devices with wattage support > 300W, Excel/API support. Calculated safe current: ~1.36A (safe for 10A plug).

## 2. Purchasing

Tuya smart plug (already owned). Compatible app allows CSV/Excel export. No extra sensor needed.  
Item | Cost (BDT)  
--------------------|------------  
Tuya Smart Plug | 1200  
Hosting (Streamlit) | 0

## 3. Configuration

Plugged refrigerator into smart plug. Set up Tuya app for logging. Logged data every 30 seconds, exported as Excel. Cleaned timestamps, removed blanks.

## 4. Data Processing

Used Pandas to compute total kWh, cost (rate = 7.5 BDT/kWh), average/min/max wattage. Made daily summary.

## 5. Dashboard Development

Tools: Python, Streamlit, Pandas. Features: Total energy, daily cost, line chart of wattage. Hosted on Streamlit.

## 6. Testing

Validated graphs vs Excel. Used with multiple data sets. Load time optimized with caching.

## 7. Completion

Dashboard public and accessible. All reports, data, and code are documented.

# Challenges and Hiccups

Problem | Solution  
--------------------------|-------------------------------  
No API support | Used Excel export instead  
Device timezone mismatch | Handled using Pandas conversion  
Hosting delay | Optimized with caching  
Manual data labeling | Preprocessed via script

# Demonstration

Dashboard: https://iot-app-application-arjst9gaxneiuqdvaeak92.streamlit.app/  
Setup Images: [Insert your image]  
Data Sample: 24-hour log of wattage  
User Manual: [Attach PDF version]

# 4. Data Visualization & Charts

This section presents key visual analytics derived from the 24-hour energy data of a refrigerator, collected through a smart plug. Charts were generated using Python (Pandas + Matplotlib/Seaborn) and displayed in the Streamlit dashboard.

## 4.1 Hourly Power Consumption

📊 [Insert Chart Here: Hour vs Power (W)]  
🔍 Observation: Power mostly remained between 106–111 W. Peak Power: 111.2 W at 1:00 PM.

## 4.2 Hourly Energy Consumption Profile

📊 [Insert Chart Here: Hour vs Energy (kWh)]  
🔍 Observation: Highest usage at 6:00 AM (0.65 kWh) and 10:00 AM (0.43 kWh).

## 4.3 Cumulative Energy Consumption

📊 [Insert Chart Here: Cumulative Energy vs Time]  
🔍 Observation: Total energy usage over 24 hours was 2.45 kWh.

## 4.4 Day vs Night Energy Consumption

📊 [Insert Chart Here: Day vs Night Comparison]  
🔍 Result: Day: 1.79 kWh (~73%), Night: 0.66 kWh (~27%).

## 4.5 Highest Usage Time Chart

📊 [Insert Highlighted Chart: Hour vs Power & Energy with Peaks]  
🔍 Max Power: 111.2 W at 1:00 PM; Max Energy: 0.65 kWh at 6:00 AM.