Home Energy Monitoring and Management System

CALIFORNIA STATE UNIVERSITY BAKERSFIELD

Team: Andrew Hasting, Anthony Mooney, Brandon Green

Professor: Amin Malek

Introduction

Problem: Homeowners cannot make smart decisions about energy consumption when no data exists past the home's utility meter.

Solution: Incorporate metering and controls into the home.

The Future of Energy: Empowering homeowners to quantify how much energy is consumed by individual devices through a smartphone interface, providing real-time data about use, and the ability to turn devices on and off.

Expected Benefits

Unprecedented level of data and energy management: Through real-time monitoring, data generation, and remote controls, users can evaluate their energy consumption and make changes by disabling devices when they are unused.

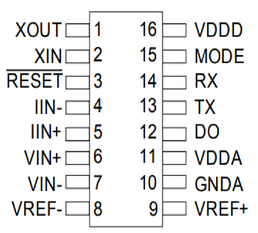
Cost savings through reduced energy consumption: Average annual electric bill in California: $3,876, an estimated 10 % of which is due to devices in standby mode, a potential $387/yr savings.

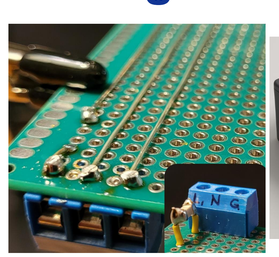
Reduced environmental impact: Incorporating this device into homes will positively affect Global Warming, helping homeowners identify waste by promoting energy only be consumed when it brings value.

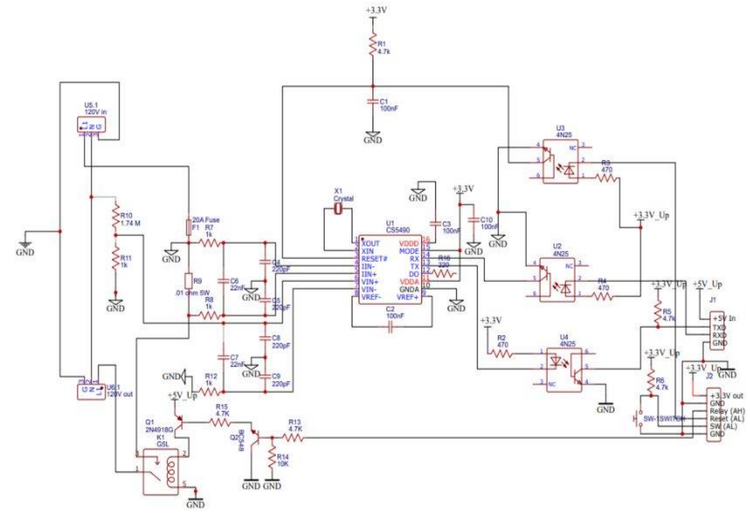
Objectives

1) Design a metering system that can measure voltage & current of a device
2) Establish communication between meter and gateway
3) Program a smartphone application to see meter readings
4) Give the user controls to turn the device on and off

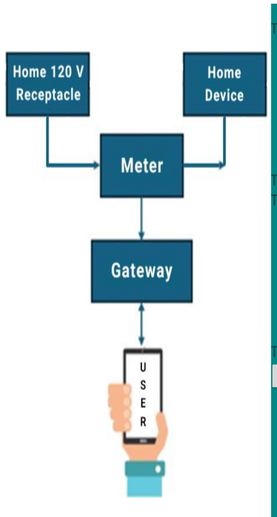
Designs

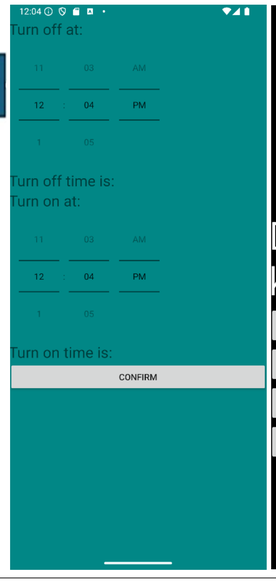


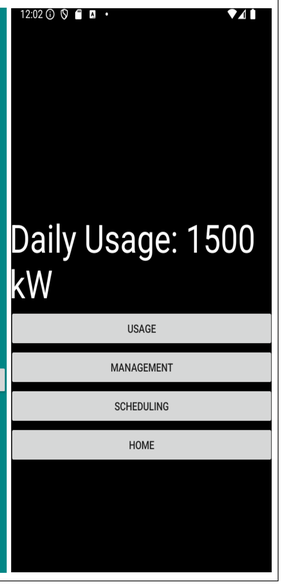




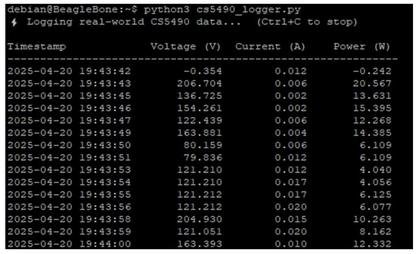
Application







Readings



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debian@BeagleBone:~$ python3 cs5490_logger.py
 Logging real-world CS5490 data...  (Ctrl+C to stop)

Timestamp                 Voltage (V)  Current (A)  Power (W)
------------------------------------------------------------
2025-04-20 19:43:42        -0.354       0.012        -0.242
2025-04-20 19:43:43       206.704       0.006        20.567
2025-04-20 19:43:45       136.725       0.002        13.631
2025-04-20 19:43:46       154.261       0.002        15.395
2025-04-20 19:43:47       122.439       0.006        12.268
2025-04-20 19:43:49       163.881       0.004        14.385
2025-04-20 19:43:50        80.159       0.006         6.109
2025-04-20 19:43:51        79.836       0.012         6.109
2025-04-20 19:43:53       121.210       0.012         4.040
2025-04-20 19:43:54       121.210       0.017         4.056
2025-04-20 19:43:55       121.212       0.017         6.125
2025-04-20 19:43:56       121.212       0.020         6.077
2025-04-20 19:43:58       204.930       0.015        10.263
2025-04-20 19:43:59       121.051       0.020         8.162
2025-04-20 19:44:00       163.393       0.010        12.332
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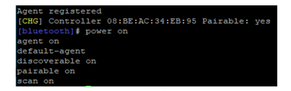
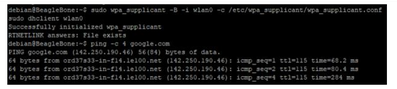
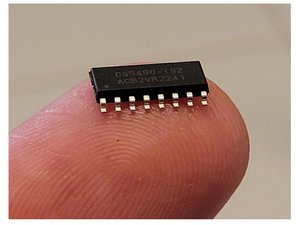




Purpose of Project

Built on the SOIC: CS5490

- Measure Voltage
- Measure Amperage
- Calculate Power
- Calculate Energy
- Open & Close Circuit
- Transmit data from meter, through gateway, to the user



Prototype