Insight Power Smart Outlet

Team 15 || Advisor : David Irwin
Brendon Burke
Mark Chisholm
Garrett Olson
Kriss Strikis
Motivation

- Provides fully automated tracking of power usage
- Greater control over devices, allows for power saving protocols (i.e. “power down” unoccupied room)
- Autonomy provides peace of mind to user.
Problem Statement

- 30-40% of energy in a home wasted on average.
- Smart devices can be difficult to manage/tedious to set up
- Difficult to track device-specific power usage
- Devices plugged in are not always the same
- Current technology only offers “semi-automation”
Usage Case: Lights in Your Home

● Other “Smart” Outlets:
  ○ May/May not provide ability to turn off all lights in house when leaving.
  ○ Cannot track when devices are moved or switched; device type tied to outlet, not power data
  ○ Can lead to catastrophe (i.e. fridge plugged into outlet designated as light)

● Insight Power Smart Outlet
  ○ Potential for any number of power saving protocols
  ○ Devices are classified by power data, not manual input. Constantly updating.
  ○ Automated safeguard against such catastrophe.
System Requirements

- Plug easily into wall outlet, remains firmly in place once plugged in.
- Connect wirelessly to app
- Measures and graphs (via app) power usage in real-time
- Turn device on and off via app
- Continuous analysis of usage data
- Classify devices based on data into different categories (lighting, heating/cooling, etc)
- User-Friendly companion app
System Specifications

- Measures power usage at least **once per second** within 1%
- Companion app updates **once per second**
- Communication between app and outlet takes at most **1 second**
- Ideal Accuracy:
  - True Positive: 50%
  - True Negative: 50%
  - False Positive: 0%
  - False Negative: 0%

- Target Accuracy:
  - True Positive: 40%
  - True Negative: 40%
  - False Positive: <1%
  - False Negative: 19-20%
Block Diagram

Mains (110v)
- Device Power NEMA 5-15

Device (Lamp, TV, etc.)
- Device Power NEMA 5-15

Smart Meter Enclosure
- Fuse
- Power Supply 3.3V
- Power Supply 5V
- Energy Measurement Integrated Circuit
- Optocoupler
- Device Relay

Data Analysis and Control
- UI TX/RX
- Device Classification
- Relay Control
- Energy Measurement IC TX/RX

On/Off

User Interface
- Relay Scheduling
- Device Information and Settings
- TX/RX

High voltage side
Low voltage side

WiFi XML-RPC
Power data, App commands
Proposed Deliverables

Hardware (Smart outlet):

- Outlet can send/receive data wirelessly from companion app at least once per second
- Outlet will read power data at least once per second
- Measure power usage of device within 1% of benchmark (Kill A Watt)
- Device turns on/off within 1 second of issuing command from companion app

Software (Companion app):

- Power usage data updates once per second
- Displays a graph showing data from the last minute
Achieved Deliverables

Hardware (Smart outlet):

- Outlet can send/receive data wirelessly from companion app at least once per second
- Outlet will read power data at least once per second
- Measure power usage of device within 1% of benchmark (Kill A Watt)
- Device turns on/off within 1 second of issuing command from companion app

Software (Companion app):

- Power usage data updates once per second
- Displays a graph showing data from the last minute
Looking Ahead

- Finish implementing & Expanding App
- Implementation & Integration of Classification Functionality
- Manufacture additional outlets
- Refine Hardware & design Case
- Move up to full AC
CDR Deliverables

- Measures power at full voltage AC within 1%
- Simple classification algorithm (Light vs Not Light)
- Prototype PCB
- App communication with multiple outlets at once
Demo