

Modeling Entertainment Devices - Research on progress -



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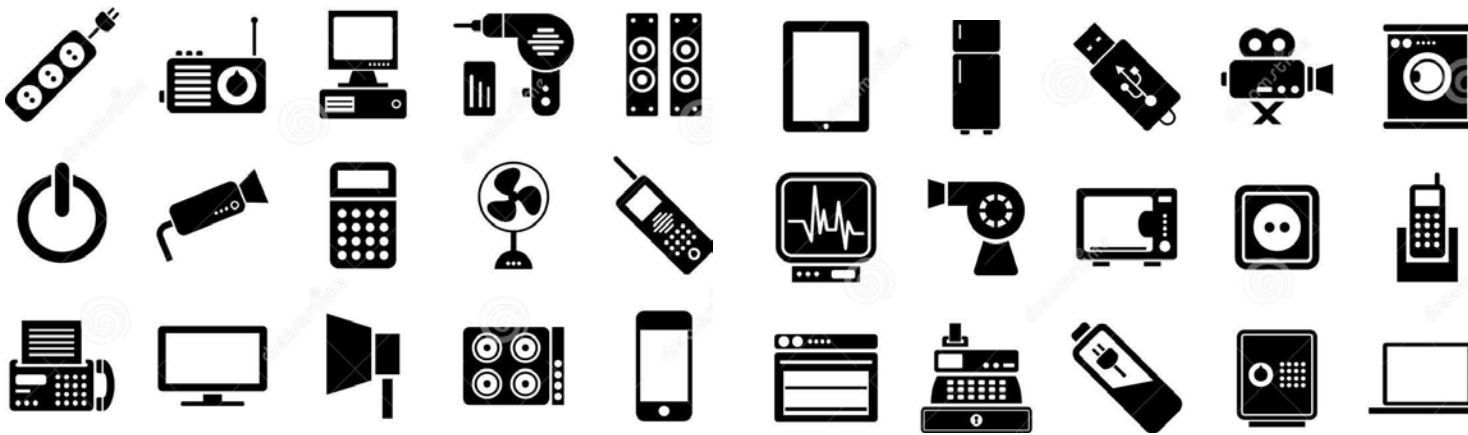
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The well-known Problem of PLDs

Plug Load Devices (PLDs) vs Lighting / HVAC

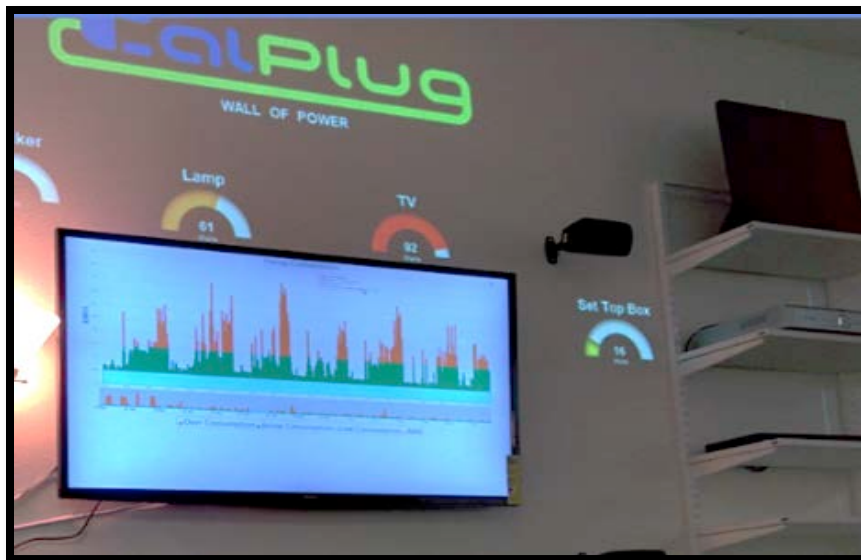
- Growing # PLDs will reach 50% usage electricity by 2020.
- PLDs are diverse and complex. Over 3 billions in The U.S.
- PLDs are dynamically introduced in a household over time.
- PLDs are not localized and do not have fixed running times
- PLDs consumption strongly depends on users' behavior



Case Study: Entertainment Systems (ES)

Current ES are multidevice-networked system

- TV, Blu-ray player, Set-top box, game console, and sound system.
- Occupy Americans for an average of five hours every day.
- They consume 800 kWhr / household annually, (9 TWhr in California)



Research Goals

Create automated and non-intrusive systems able to

- Track and understand the use of PLDs to identify behaviors that waste energy.
- Perform fault-detection.
- Classify PLDs that are not efficient and propose replacement.



Previous Work: The Wall of Power

What is Wall of Power

- Interface to help users to improve Energy Efficiency at home.

Main Features

- Monitor/control individual consumption directly on the wall or a mobile device.
- Build an open product database to assist finding top energy efficient devices.



Creating Connections. Powering Innovation. Boosting Efficiency.

Current Work

- **Understanding usage and providing personal advice**
 - based on user's preference to purchase new products.
 - Identify user's preference on price, performance and energy efficiency.
 - List top energy products according user's preferences.
 - based on installed PLDs.
 - Classify current devices and its operational energy modes.
 - Compare installed devices with top efficient products.
 - based on user's behavior.
 - Register operation for each device time/energy consumption.
 - Provide advise/management to avoid wasting habits and propose more suitable products.



Research Challenges

- **Understanding usage and providing personal advice**
 - based on user's preference to purchase new products
 - Identify user's preference on price, performance and energy efficiency.
 - List top products according user's preferences
 - based on current PLDs
 - Classify current devices and its operational energy modes.
 - Compare installed devices with top efficient products
 - based on user's behavior
 - Register operation for each device time/energy consumption
 - Provide tips to avoid wasting habits or more suitable products.



Possible Solutions

Solution

Engineer

Consumer

Install plug meters and sensors everywhere



Ask consumers to register their devices models and usage



Design non-intrusive, deployable and automated solutions

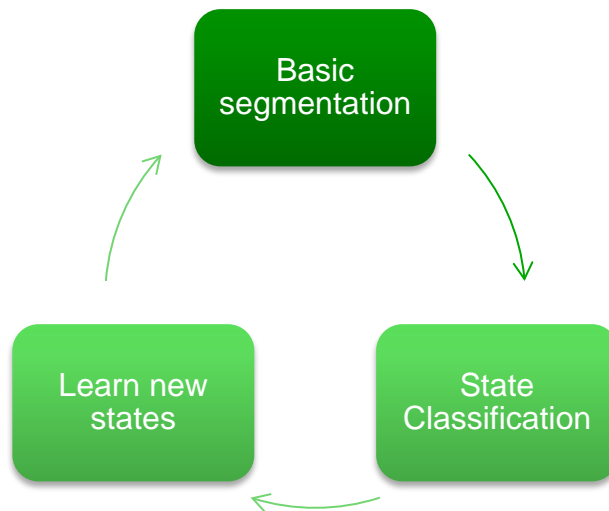


Proposed Solution

Statistical approach for PLDs Classification via Machine Learning

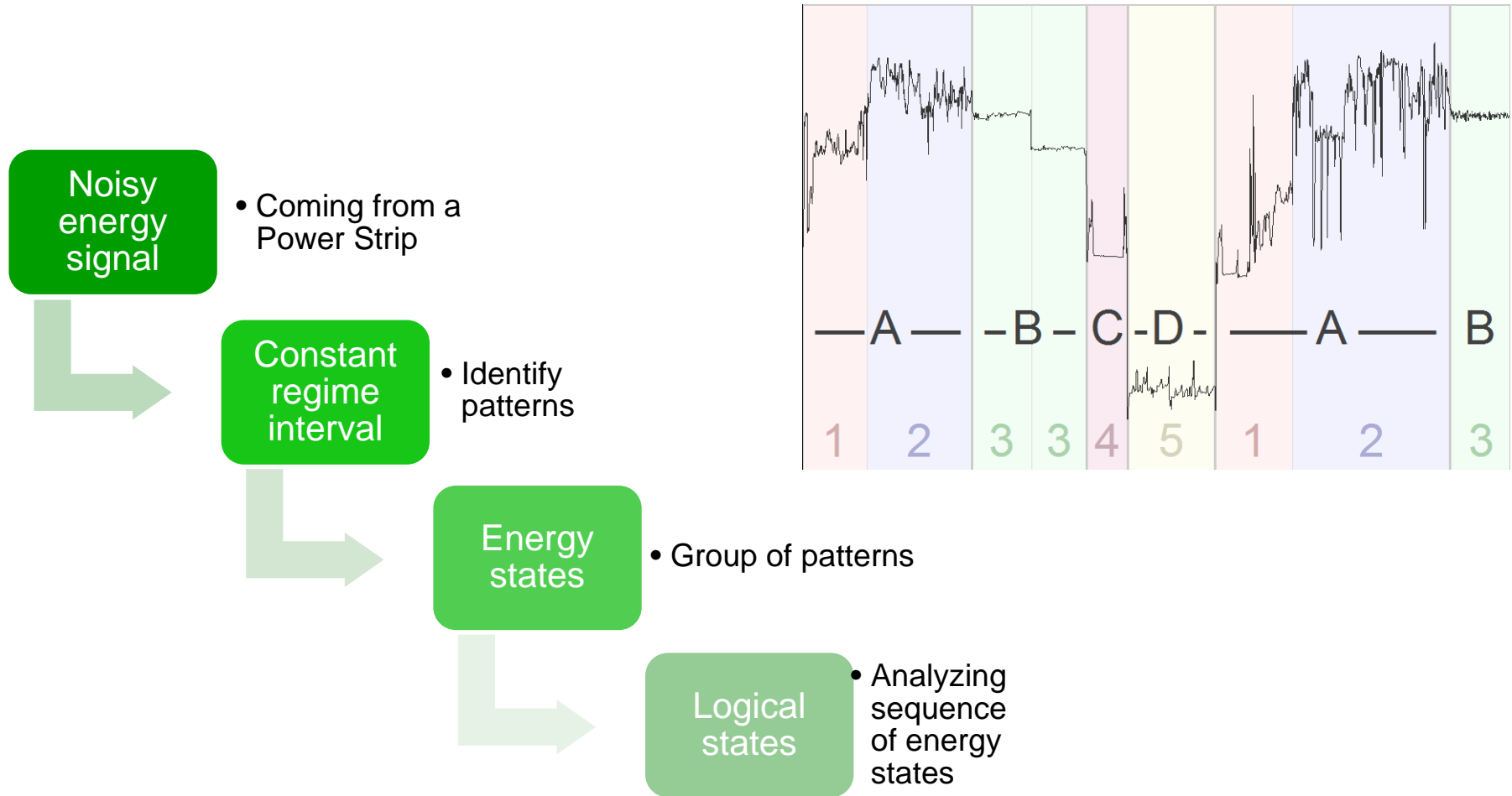
- Modeling PLDs energy signature for each power state.
- Building algorithms to disaggregate superposed data.

Methodology of PLD identification



Proposed Solution

Modeling & Classifying energy states of PLDs



Preliminary Results

Modeling & Classifying energy states of a Game Console: Xbox



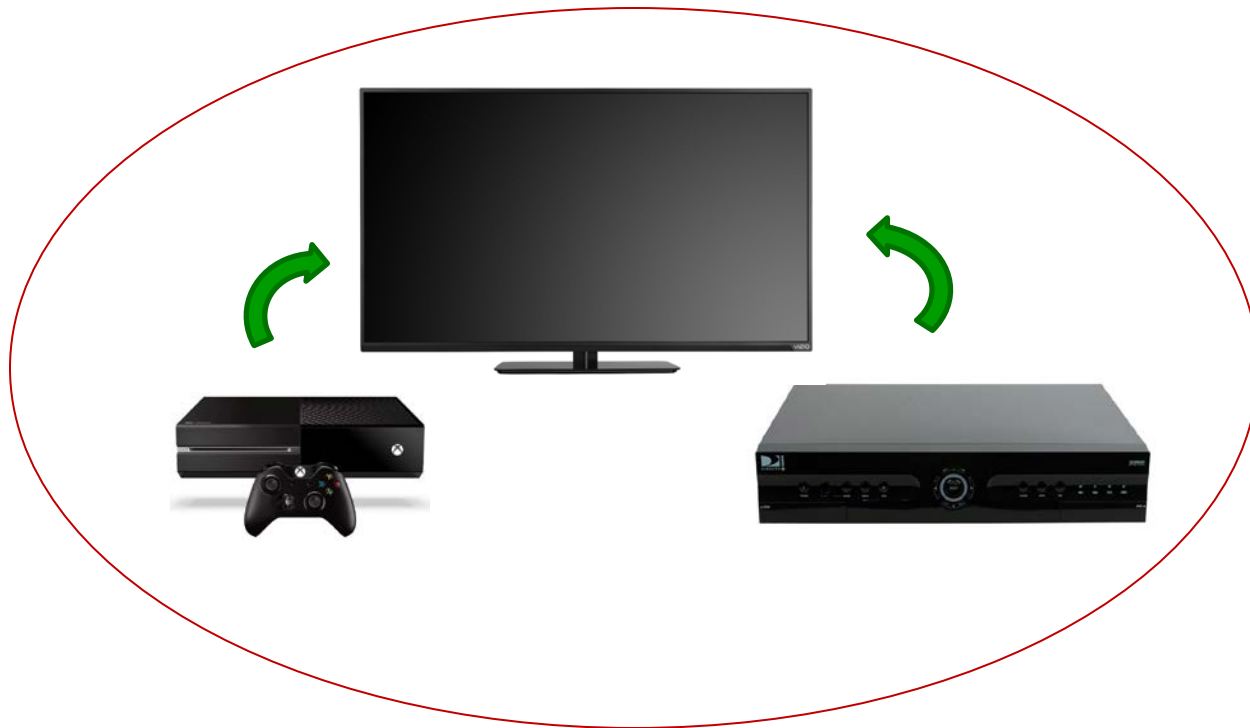
88-95% Success

Xbox Logical States

1. Playing games
2. Inactive while game paused
3. Instant-on mode
4. Playing Movies
5. Playing Music
6. Main menu
7. Energy-saving mode
8. Playing games with Kinect

Future Work

- Improving the training algorithm to achieve a higher rate of success.
- Modeling Set-top box and integrate it in the current system.
- Use external data for presence detection (GPS, Wi-fi)



Previous Work: The Wall of Power

Thank you!

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