Smart Communication of Energy Use and Prediction in a Smart Grid Software Architecture

Saima Aman, Yogesh Simmhan and Viktor Prasanna
University of Southern California, Los Angeles, CA

Smart Grid Environment
- Advanced monitoring and metering systems provide real-time data on energy use
- Energy consumption data can be analyzed and fed back to consumers
- Improves consumer insight and engagement, and promotes energy conservation behavior

Smart Communication with Consumers

Problem: Effective communication of energy use and prediction to the consumer
- Providing detailed consumption information in itself may not lead to a change in consumer behavior
- Need to provide aids for interpreting information and tips on specific actions to take

Smart Grid Software Architecture

Energy Use and Prediction Modeling

Approach: Apply Machine Learning methods to model energy use by consumers

Services for Consumers:
- Energy Monitoring tools
- Sharing & comparing usage data with other parties
- Track consumption change with change in appliances/equipment
- Provide appliance-level consumption details
- Explain unusual usage activity
- Learn from historical data to predict energy use patterns

Tools for Utility:
- Predict peak demand on power grid
- Predict usage for new customers
- Cluster customers into sub-groups for targeted incentives
- Provide individual usage data & analysis
- Data mining for fault detection

Energy Use and Prediction Modeling

Approach: Apply Machine Learning methods to model energy use by consumers

Services for Consumers:
- Energy Monitoring tools
- Sharing & comparing usage data with other parties
- Track consumption change with change in appliances/equipment
- Provide appliance-level consumption details
- Explain unusual usage activity
- Learn from historical data to predict energy use patterns

Smart Energy Use and Prediction Communication Model

Premise: Make information comprehensible, personalized and actionable

- Textual information to accompany numerical data in form of tables and graphs
- Consumers can sign up for routine messages:
  - Energy usage and prediction information
  - Demand Response and pricing messages
  - Targeted incentives from the Utility
  - Suggestions about specific actions to take
  - Explanation of salient features of usage and any unusual usage

Need: To automatically generate text messages based on the numerical data

- Advantages of using textual data:
  - Easy to comprehend; help interpret graphical data
  - Can be combined with Text-to-Speech (TTS) systems and Machine Translation (MT) systems

Research Challenges

- Modeling user information (needs to be continuously updated based on change in behavior)
- Predicting energy usage based on past consumption, user models and other contextual data
- Automatically generating information in natural language from structured numerical data
- Generating personalized feedback (tailored in ‘content’ and ‘style’ to individual users)

Center for Energy Informatics
(cei.usc.edu)
This work is being carried out at the USC Center for Energy Informatics (CEI) and is supported by the US Department of Energy (DOE) and the Los Angeles Department of Water and Power (LADWP).