Non Intrusive Load Monitoring

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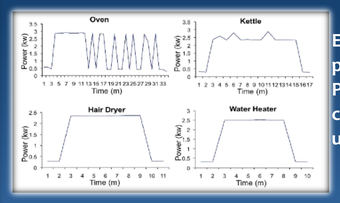
Motivation

Real time appliance level information can save upto 12% energy annually

Instrumenting each appliance

* Costly (Proportional to # appliances)
* Intrusive
* Difficult for loads such as lighting

Appliance Signatures



Each appliance has a unique power signature

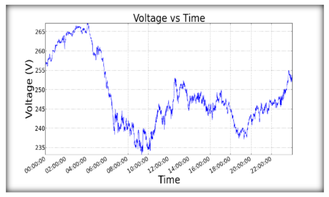
Pattern recognition techniques can be used to find appliance usage from meter level data

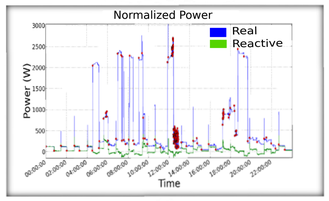
Problem Definition

"Analyzing changes in the power going into a house to deduce what appliances are used in the house"

Appliance Signatures → Pattern Recognition → Electricity Meter Data → Appliance Usage Information

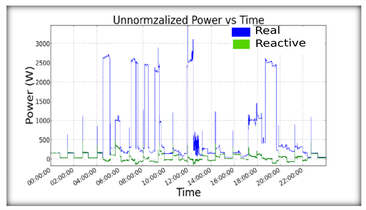
Data Preprocessing

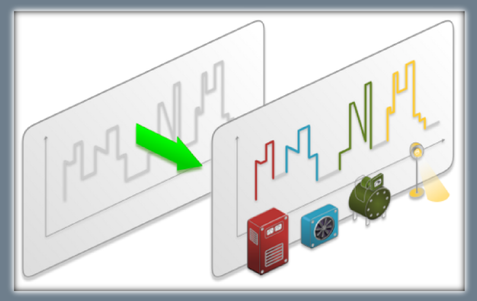




$$P_{norm} = P_{raw} \cdot (\frac{230}{V})^2$$

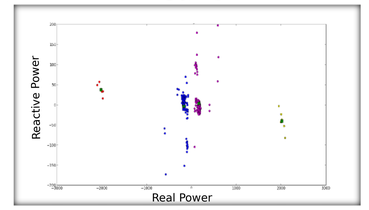
Raw Power Plot



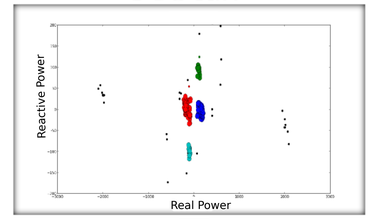


Appliance Step Change Clustering

KMeans



DBScan



Insights

Home 1: Power Breakdown

Home 1: Floor-wise Power Breakdown

Monthly Cost

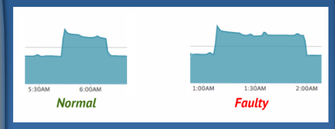
Refrigerator: Rs. 120
Geyser : Rs. 720

Applications

Recommendations

"You can save 3 trees from getting cut if you replace your washing machine with a more energy efficient one."

Fault Detection

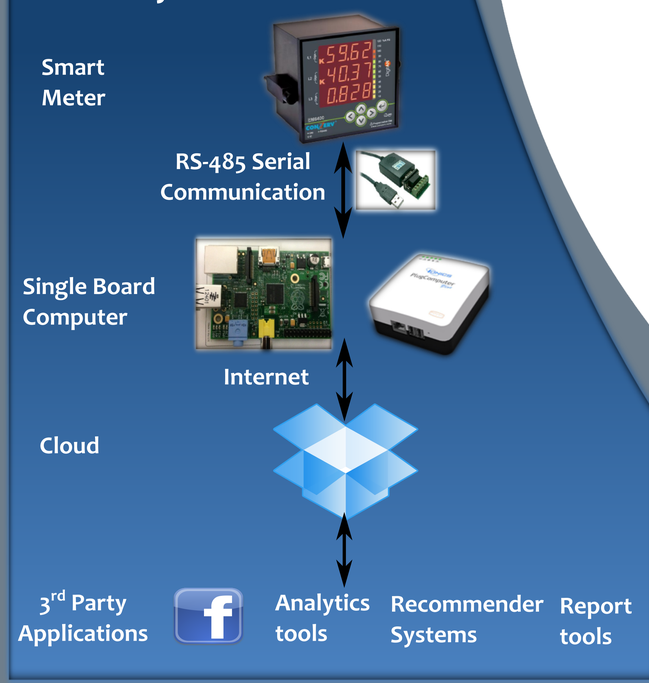


Load Shifting

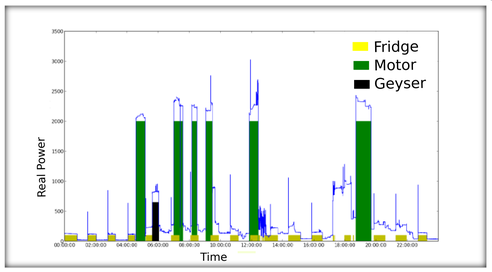
"Peak demands result in higher transmission losses."

Small reduction in peak usage significantly reduce overall costs.

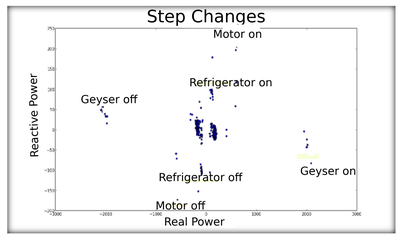
System Architecture



Disaggregated Appliance wise Power Consumption



Appliance Step Change Manual Annotation



Future Work

Richer Feature set:

* Certain appliances likely to be on at certain times of day/season- Using appliance temporal dynamics
* Certain appliances likely to be used together- Modeling coupling amongst appliances

Distributed data analysis: Imperative given "big" and "distributed" nature of problem

Using customized Probabilistic Graphical Models to factor dependencies

Acknowledgements

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