Predictions By Energy Analysis

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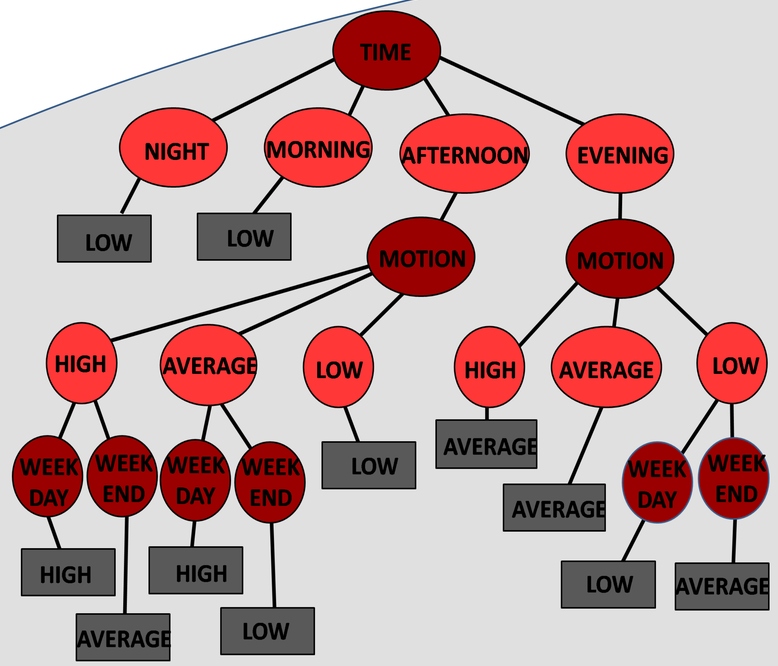
This work was supported by the National Science Foundation's REU program under grant number: ISS-0647705

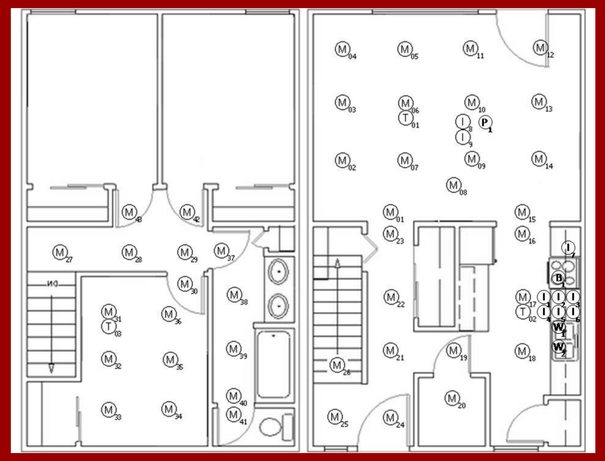
Introduction

Furthering research in the smart environment relies on the computer's ability to recognize the activities of daily living being performed within the environment. Researchers at Washington State University have combined data collected by motion, temperature, and contact sensors to teach the computer and predict activities.

Goal

In an attempt to improve the computer's accuracy in predicting activities within the smart environment, a power meter has been added to the environment. By combining the power readings with the other sensor data, another attribute has been added for use in predicting activities of daily living. To begin research on this area, the question becomes: *Can we predict power usage over an interval of time given the time of day, day of week, and motion in the environment?*





Smart Environment Layout

Future Research

Further research can be conducted by testing with more attributes. Using annotated data, motion sensor data with the activity that was being conducted labeled within, learning algorithms can be run to see if the computer will recognize activities based off of the combination of sensor events.

Testing

Learning algorithms were then applied to the classified data. Using WEKA, a data mining software from the University of Waikato in New Zealand, the data underwent the naïve bayes classifier as well as a decision tree algorithm. The resulting tree is displayed. In order to determine the other relations between the attributes, tests were also run to determine the accuracy in predicting time of day, day of week, and motion totals.

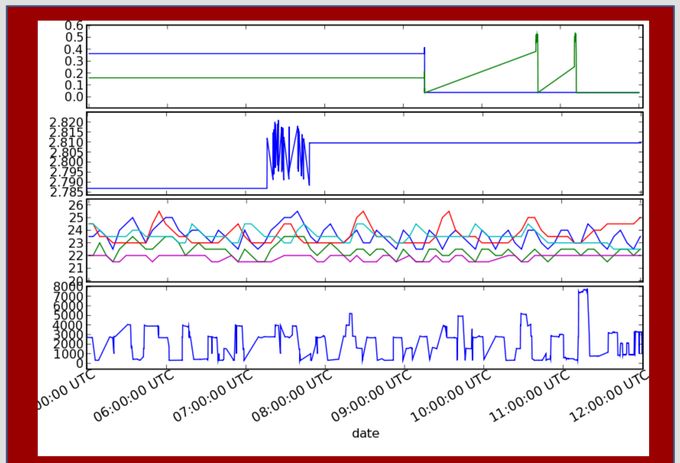
Results

Running the naïve bayes classifier and decision tree algorithm on the data resulted in the following accuracies:

- Wattage:
  - Naïve Bayes: 45.81%
  - Decision Tree: 48.45%
- Time of Day:
  - Naïve Bayes: 42.82%
  - Decision Tree: 43.68%
- Day of Week:
  - Naïve Bayes: 71.99%
  - Decision Tree: 71.99%
- Motion Total:
  - Naïve Bayes: 66.41%
  - Decision Tree: 67.94%

Classifications

By placing two people in the smart environment over a period of three months, sensor events were collected. Every six seconds, a power reading was taken and stored if the wattage usage had increased or decreased by a minimum of ten watts over the six second interval. Every motion sensor event was recorded with the power readings. Days of the week were broken up into weekdays and weekends. Time of day was classified as morning, afternoon, evening, and night. The number of motion sensor events were counted depending on the time of day in which they were set off. From there, the motion sensor events were classified as either a low, average, of high amount of movements. The number of watts were totaled for every hour of the day. They too were placed into the categories of low, average, or high wattage usage.



Power Outputs