

A Novel approach to Home Power Management based on User Behavior and Machine Learning

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Electronic appliances, such as air conditioners or lights, being left ON when they are not being used is a significant source of energy wastage. Past studies have shown that 20-30% of energy used by these electronic appliances could be saved by turning OFF these electronic appliances when they are not in use.

This paper aims to reduce the energy consumption of these electronic appliances. The solution proposes to cut energy wastage by analyzing similarity patterns between electronic appliances and Wi-Fi devices' usage. Based on these similarity patterns, the program will turn OFF electronic appliances when appropriate. Wi-Fi devices such as laptops and cellphones will serve as a good indicator of a person's electronic appliance usage. For example, a person using his phone and laptop at the same time intervals he uses his bedroom light, would indicate that the bedroom light behavior is dependent upon the visibility of the phone and laptop on the local Wi-Fi network. If the person was to leave the household with his computer and cellphone (devices will not be connected to the Wi-Fi network anymore since the person has left the household) then the bedroom light would turn OFF due to the dependence upon the Wi-Fi devices.

The approach taken to implement this solution is as follows:

- Collection of Data: To monitor Wi-Fi devices and electronic applications' visibility status (ON/OFF), the ping program was used to collect data every minute..
- Analyze Patterns: Machine learning algorithm was used to deduce which Wi-Fi devices and electronic appliances had similar usage patterns.
- Reducing Energy Usage: Based on similarities between electronic appliances and Wi-Fi devices, electronic appliances were turned OFF automatically when necessary.

In order to test the success of the program, one bedroom was observed. Data was collected for 21 days with the program deciding randomly each day whether or not the machine learning algorithm would be applied. Based on a two-sample t-test yielding a P-value of 0.031495, I concluded that the program did decrease the amount of power used. I am 90% confident that the interval from 0.032557 and 0.490643 megawatts captures the mean amount of power which is saved by the machine learning program in comparison to without the machine learning program. This experiment serves as an indicator for the success of this machine learning program in reducing energy wastage. The program, easily accessible to an average household, can provide a huge impact in saving energy.