Docket #: S17-240

Smart Dimmer Fuse – Energy Demand Management at the Circuit Level

Abstract
Stanford researchers have developed a 'smart' replacement for conventional circuit breakers that controls energy usage on the circuit level. The Smart Dimmer Fuse (SDF) will replace traditional home circuit breakers to control electricity use based on residents' preferences, while also improving safety. The device will include power electronics for load curtailment, and load measurements.

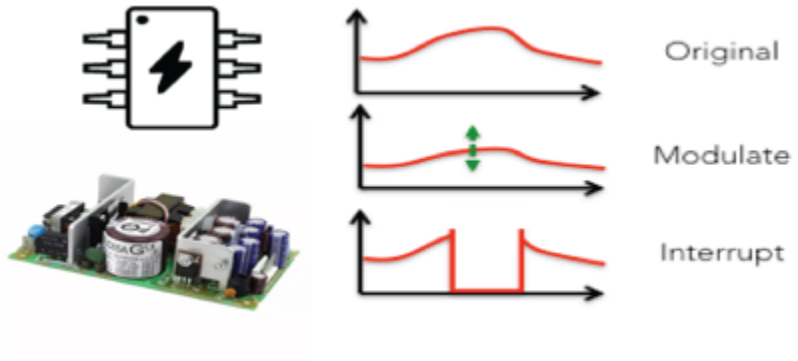

Figure 1: Smart Dimmer Fuse on a local circuit

SDFs installed at the breaker panel for key subcircuits measure the voltage and current, and can control the subcircuit voltage. First-level reductions are generally unnoticeable, e.g. pausing electric water heaters or air conditioning systems when nobody is home. When electricity prices rise to the point where residents have indicated they accept more noticeable load reductions, SDF can dim lights or suspend the clothes dryer running. The ability to control electrical power consumption intelligently and precisely is important with increasing energy sources with variable output, such as wind and solar.

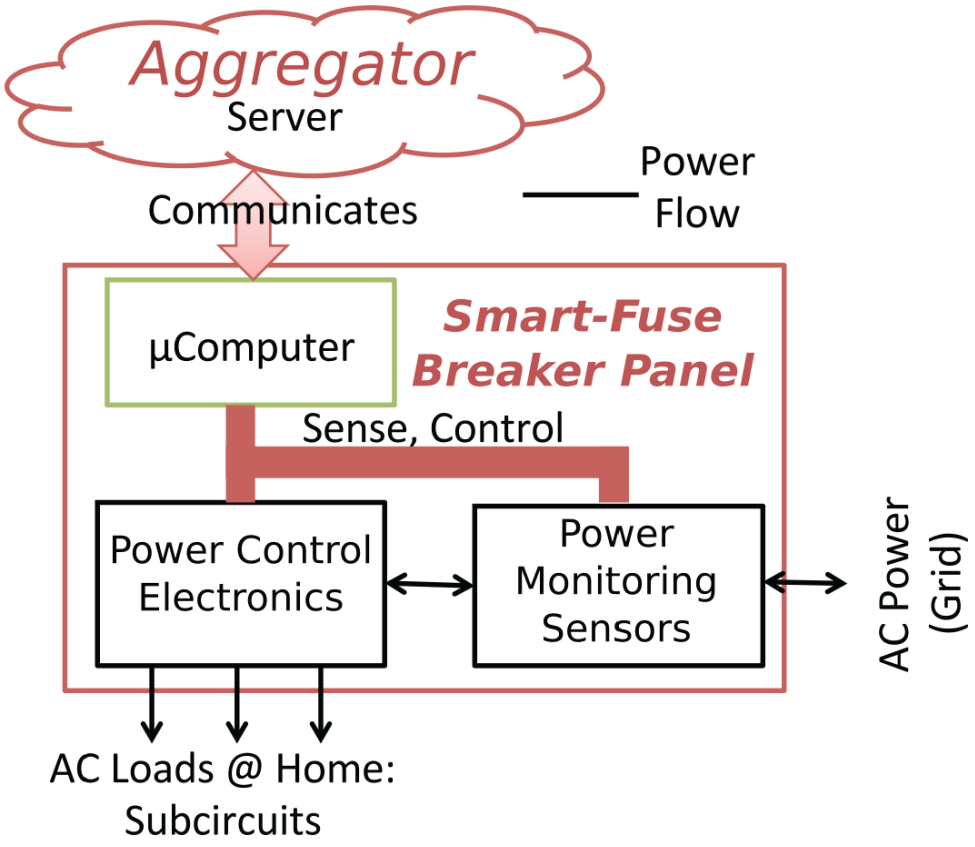

Figure 2: Smart Dimmer Fuse System showing power monitoring, control, and communications to aggregator server.

Stage of Research

Stanford researchers have tested the first working prototype. Using data from 131 homes, they've demonstrated it is possible to achieve roughly 5% load flexibility without power interruption. Full prototype with power measurements, communications, and embedded processing is under development.

Applications

- Replacement for conventional circuit breakers or fuses, especially in “smart buildings.”
- Energy Demand Response Programs

Advantages

- Greater safety than thermal-magnetic breakers in use today.
- More accurate - provides real time data on power consumption vs. voltage of the load.
- Versatile
    - Alters voltages without complete power interruption, providing a larger pool of demand-side resources for grid services aggregators.
    - SDF functionality could be extended to other applications, such as plug-level load monitoring and control, or voltage control and monitoring for entire homes or panels.
    - Extend use from residential to commercial retrofits for buildings that lack smart, networked controllable loads.
    - Single phase AC to multi-phase AC applications - 3-phase SDF installed on a circuit that powers a large HVAC induction motor becomes a variable speed drive, leading to load flexibility and potential increase in motor efficiency.

Publications

- Goldin, Aaron, Ram Rajagopal, Claudio Rivetta, and Juan M. Rivas Davila. "The “Smart Dim Fuse”: A new approach to load control as a distributed energy resource." In Control and Modeling for Power Electronics (COMPEL), 2017 IEEE 18th Workshop on, pp. 1-7. IEEE, 2017.

Patents

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