INVENTION DISCLOSURE

1. **Invention Title.**

Learning Home Air Conditioning System with Smart Air Registers and Returns

2. **Invention Summary.**

Creating the most efficient heating/cooling system for a home, without heavy infrastructure re-engineering, through smart sensor air registers and returns, which operate as a neural network and determine the optimal air flow conditions through a learning process.

3. **Invention Description**.

The single largest component of energy use (and hence $$) in air conditioned homes is the cost of running the air conditioning in the summer.

Existing domestic heating/cooling systems are very rudimentary, extra-ordinarily inefficient, and often result in poor end user results. They gave very few elements that can be controlled, and very few sensors. The advent of inexpensive mesh networked sensors allows the proliferation of both sensing (airflow, temperature) and control (airflow for outbound registers and air returns). The invention presumes the creation of small, relatively inexpensive, battery operated, mesh networked air registers and returns that sense the airflow and air temperature, along with the ability to control the airflow.

It has become apparent that a typical home has the following control and sensing elements within the heating/cooling system:

1) Single temperature measuring location, normally at the thermostat on the main level of the home

2) Single airflow setting (on or off, normally with a single speed motor, though dual or multiple speed motors are becoming more common)

3) Single cooling setting (on or off, though a small population of higher end homes have dual condenser systems)

4) Single heating setting (on or off)

The home-owner has other levels of "persistent, manual" control, through adjusting the setting of each register. This is very hit and miss.

The home is typically engineered by the builder to attempt to balance the airflow across all rooms within the home to achieve uniform heating and cooling, but this is done as a singular design activity which then persists for the life of the home. Rarely is this the optimal design for the home, and results in major inefficiencies that translate to excess energy use and unnecessary expenditure on power by the homeowner.

These minimal control and sensing capabilities result in homes which are typically hot upstairs in the summer, and cold in the basement. This paradigm is so commonplace that attic fans are specifically designed to address this situation by pulling air from the basement to displace the hotter air in the upper levels of the home.

In my attempts to correct this manually, through various attempts to close off air returns or registers

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in the basement in the summer, it has become clear that it is not intuitive or obvious what measures generate the best outcome in terms of uniform cooling of a home. Should I close the returns in the basement to cause more hot air to be sucked through the returns upstairs? Or should I leave the basement returns open to allow them to pull cooler air from the basement and push it to the upper floors? It seems likely that I should close the air registers in the basement to stop cold air coming out of the lowest impedance path from the air conditioner. But doesn't this obstruct airflow back through the basement returns?

This leads me to the revelation that I just don't know what the best configuration is. If every register and return can sense airflow and temperature, and can control airflow, then the system can create the maximal comfort for the homeowner by learning the impact of changes it makes. The system as a whole can create stimuli (adjusting the flow through each element) and measure the effect both locally and on other areas of the home. Making the system a neural-network-based learning system will allow it to change N values (the airflow at each inlet/outlet) and understand which of these changes lead closer to the desired outcome.

One of the beauties of this invention is that it does not require the replacement of existing "heavy infrastucture" elements, such as the furnace/airconditioner compressor coils/blower motor. It may not even require replacement of the existing thermostat (though this would also likely be replaced at the time of installation). As the registers/return grilles are self-contained, the old ones can simply be unscrewed from the wall and replaced with the new elements.

However, battery operated devices that cause physical movement of the grille for airflow are likely to have inconveniently short lifetimes before battery replacement. The invention is further enhanced through having the airflow detector also act as a trickle recharge of the battery, extending the time before battery replacement to several years.

The general assumption is that the system would regularly adjust airflow during the "learning period", but would likely leave the airflow static once the optimal configuration is achieved. It is anticipated that there would be seasonal adjustments of the airflow through the system as the system switches from cooling to heating and vice versa, but that battery life would be conserved through not adjusting too regularly.

In addition, the airflow sensing is likely to enable the sensing of ancillary information such as "you seem to have left the basement door closed - this makes your cooling less efficient" and notify the customer.

Briefly outline the potential commercial value and customers of the invention.

It is likely (gut feel) that energy savings in excess of 15% could be achieved through this system, along with greater comfort for the homeowner. Savings are likely to be in excess of existing "smart" or "learning" thermostats that focus on learning the thermal mass of the home, and how early to switch on to achieve the desired temperature at the desired time. They are still limited by a single sensor value and their only ability being to turn the cooling on and off.

Consumers are likely to be willing to pay for such a service, when sold on the cost savings they would achieve overall. Cable operators could capitalize on this through service charges as part of a home management solution.

4. **How is this invention different from existing products, processes, systems?**

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Existing "smart" or "learning" thermostats (Nest, Ecobee etc.) work to save energy through deciding the optimal time to turn on cooling and heating to achieve the desired temperature at the desired time (like "I want it to be 72F by the time I get home at 5:15pm"). They do nothing to adjust the airflow throughout the home to achieve the optimal application of cooling to the home. In addition this has the benefits of being able to provide whole-home temperature sensing and potentially differential target temperatures in each room.