SMART VENTILATION SYSTEM

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ABSTRACT

Air ventilation is one of the top energy users in residential buildings. Smart ventilation equipment and controls help to reduce the amount of energy use attributable to ventilation in homes while maintaining high indoor air quality. Ventilation can also be used as a resource for utility grid demand response if done intelligently. A key component of the smart ventilation concept is the use of controls to ventilate more when doing so provides an energy or air quality advantage and/or a resource to the power grid, and less when it provides a disadvantage. Unlike demand-controlled ventilation, other smart ventilation concepts involve the addition of several new inputs into control algorithms—namely measured or modeled concentrations of pollutants and signals from the electricity grid. And, unlike demand-controlled ventilation, smart ventilation uses the "equivalent ventilation" principle in the selection of the control strategy, which allows anticipation of future ventilation needs and retroactive compensation for previous ventilation needs.Suitability of common environmental variables (pollutants of concern, humidity, odors, CO2, occupancy) for use as input variables in smart ventilation applications. Availability and reliability of relevant sensors. Different control strategies used for a smart ventilation approach. Results of the review showed that the suitability of each environmental variable is specific to each smart ventilation application, and also that pollutant sensors are currently not robust or accurate enough to be relied upon for residential ventilation controls. Next, this research assessed the regulatory context in which smart ventilation strategies might be implemented most effectively. The assessment showed that many countries already have a regulatory structure that is favorable for the development of smart ventilation strategies. These countries have regulations and standards in place that propose "equivalence methods" that offer a path to compliance including the use of smart ventilation strategies. These compliance paths have allowed for the development and availability of demand-control ventilation systems in the marketplace; more than 30 such systems have been approved and are available in countries including Belgium, France, and the Netherlands. It seems likely that the more complex smart ventilation strategies would follow a similar path to market acceptance. This meta-analysis of 38 studies of various smart ventilation systems with shows that ventilation energy savings of up to 60% .. Finally, this report summarizes ongoing developments in smart ventilation strategies and applications, including research into indoor air quality metrics, feedback on the lack of quality in ventilation installations, and source control (filtration and air cleaning) issues.

Keyword : *- Smart, Ventilation, DCV, Indoor air quality, Health, Energy, Performance, Sensors, Pollutants.*

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1. INTRODUCTION

Ventilation is a driver of both 1) indoor air quality (IAQ) considerations in residential buildings and 2) energy use in residential buildings (conditioning ventilation air and fan power requirements). In order to provide both improved IAQ and energy performance in residential buildings, ventilation must become aware of what is happening in the space and its own impact; that is, it must become smarter. *Smarter ventilation* provides higher performance whether that performance is more energy-efficient, conducive to improved IAQ, or it also takes into consideration the needs of the power grid and potential future variable costs of electricity. Through updates to California building codes, California is leading the way to energy-efficient residential buildings, and is even on the way to mandating zero-net-energy homes. This is also the case in some European municipalities, in response to energy performance building directives from the European Parliament (2010). For these high-performance homes, envelope airtightness treatment becomes crucial and should be combined with efficient ventilation technologies. Ventilation loads in high performance homes represent a significant and increasing fraction of the space conditioning load and thus smart ventilation become an increasingly useful approach.

Great strides have been made in improving envelope airtightness in residential and commercial applications, but sometimes at the cost of IAQ. Because people spend 60%—90% of their life in indoor environments (homes, offices, schools, etc.), IAQ is a critical factor affecting public health and smart ventilation concepts of the future must take it into account (Klepeis, et al. 2001; European commission 2003; Brasche and Bischof 2005; Zeghnoun, et al. 2010; Jantunen, et al. 2011). Logue, et al. (2011b) estimated that current damage to public health from poor IAQ (excluding second-hand smoke (SHS) and radon) was in the range of 4,000–11,000 μDALY per person per year. By way of comparison, this means the damage attributable to poor IAQ is somewhere between the health effects of road traffic accidents and heart disease from all causes (11,000 μDALY/p/yr). According to the World Health Organization (WHO 2014), 99,000 deaths in Europe and 81,000 in the Americas were attributable to household IAQ in 2012. Health gains in Europe (EU-26) attributed to effective implementation of the energy performance building directive, which includes IAQ requirements, have been estimated at more than 300,000 disability-adjusted life years (DALY) per year. (Jones, et al. 2015) studied air change rates provided by infiltration only and showed that, in order to limit negative health consequences, up to 79% of homes could require additional purpose-provided ventilation .*The definition and description of smart ventilation strategies, including a theoretical background. The suitability of various environmental variables for use as inputs in smart ventilation applications. The availability and reliability of the sensors used to measure these variables. Dust sensor used to detect the dust on the atmospheric air. Temprature sensor continuously moniter the room temperature and it will be shown on the LCD display.*

2. EXHAUST FAN

Two exhaust fan are used for a ventilation. Exhaust fan 1 is used to remove the air from the inside the room. Exhaust fan 2 is coupled with air filter and it used to feed the fresh air into the room. Sensor are used turn ON and turn OFF the exhaust fan. Arudino board output terminal is connected to the exhaust fan. Dust sensor is connected to the arudino board.

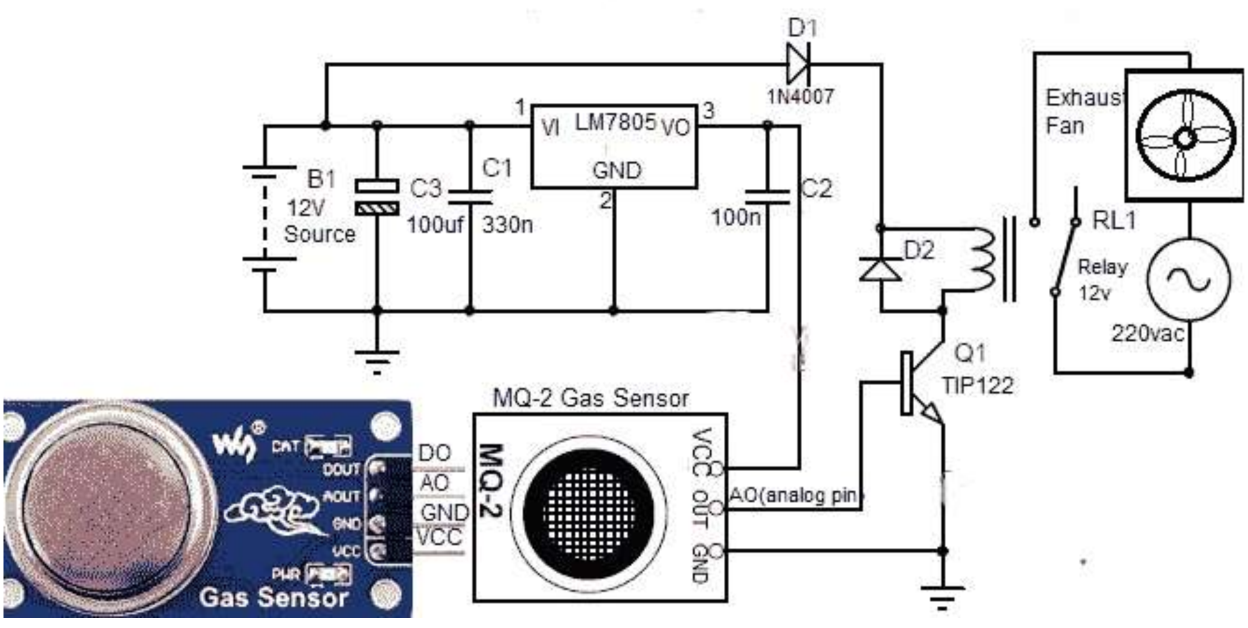

Fig -1: Exhaust fan with aurdino board

The smart ventilation concept is not fixed and has evolved concurrently with technological progress and scientific knowledge. The next generation of smart ventilation technology will be the focus of a future CEC/LBNL project, Smart Ventilation for Advanced Californian Homes (SVACH), that will include variation of airflows with indoor pollutant load and the use of air cleaning systems in response to outdoor pollution levels.

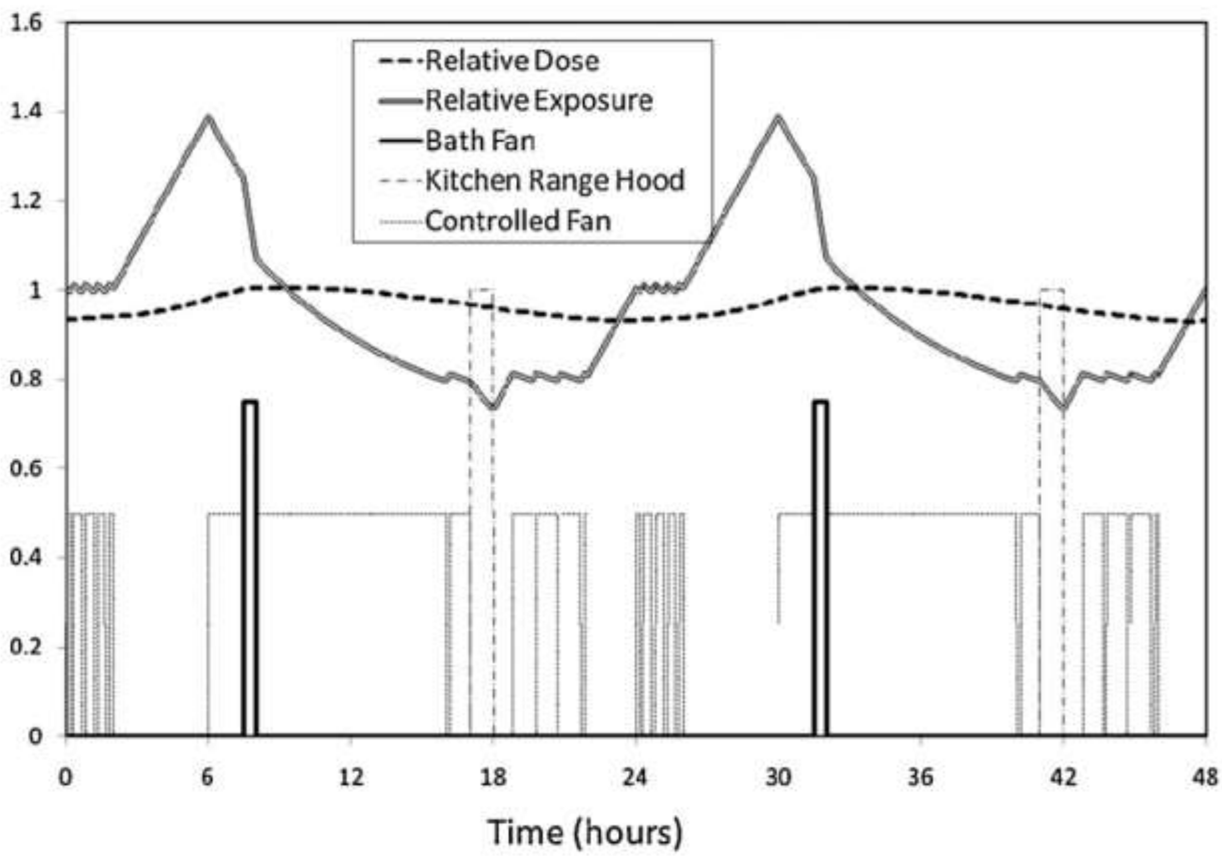

Fig-2: Graph between normal exhaust fan vs smart fan

3. Sensor

A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine. Most sensors are electronic (the data is converted into electronic data), but some are more simple, such as a glass thermometer, which presents visual data.

- Fire sensor
- Temprature sensor
- Dust sensor

3.1 Fire Sensor

Heat detectors are intended to minimize property damage by reacting to the change in temperature caused by a fire

3.2 Temprature sensor

Smoke detectors are intended to protect people and property by generating an alarm earlier in the development of a fire.

3.3 Dust sensor

Optical air quality sensor, designed to sense dust particles. An infrared emitting diode and a phototransistor are diagonally arranged into this device, to allow it to detect the reflected light of dust in air**.**

4. CONCLUSIONS

First, ventilation is provided in response to demand for ventilation rather than only a prescribed, conservative prescription on ventilation airflow rate. This example of a smart ventilation strategy has been studied and implemented fairly widely under the banner of DCV. Most often demand has been quantified in terms of occupancy, or some other measureable quantity that is usually intended to indirectly estimate occupancy, such as RH or CO_2 concentrations. Less often studied is the quantification of demand in terms of individual pollutant loads, through sensing of individual pollutants, and the allowance for reduction in demand based on these measurements. The newest and least studied and implemented approach is the reduction in calculated in demand based on other mechanisms of air entry or exhaust into a space, such as infiltration and mechanical equipment used for source removal such as kitchen hoods and bathroom fans. The second aspect of smart ventilation strategy is that it can employ the principle of equivalent ventilation to satisfy demand at times of the day that are not necessarily coincident with the demand itself. Through the equivalent ventilation principle, proper IAQ and acceptable levels of exposure to pollutants can be maintained even if ventilation quantity is not proportional to demand at any point in time. This approach allows for benefits such as shifting ventilation from times when thermal loads associated with ventilation are high to those when it will be lower. Lastly, Smart Ventilation is smart in that decisions made by a controller used in smart ventilation applications will integrate information from many sources to make an informed decision about how best to ventilate. These sources of information may include outdoor conditions such as temperature, humidity, pollutant concentration, wind speed and wind direction; indoor conditions such as occupancy, humidity, pollutant concentrations, and static pressure; whole-house conditions such as predefined schedules and the operation of other mechanical equipment; and global inputs such as community- or regional-scale demand for electricity or the prince of electricity. With this information, a smart ventilation controller can them make decisions based not just on current conditions but, conceivably, also prediction of future conditions and weighing of the appropriateness of various control strategies based on financial, energy, and air quality considerations in the future.

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