Leakage Detection

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ABSTRACT

The structural insulation artifacts of a building play a critical role on the overall building energy consumption. While the effective utilization of a multitude of appliances helps reduce the building energy consumption, equally corrective actions and timely precautions on poor insulations surrounding the air leakages of windows and doors, damps on the walls and ceilings play a critical role on increasing the efficiency of HVAC system and reducing the utility bill significantly. In this paper, we investigate the volatile temperature distributions inside the room in presence of damped walls and air leakages around the windows and doors. We prototype a low-cost low-energy IR camera based system to scan and detect the persistent air-leakages and damps. We investigate the impact of those unseen energy holes on the efficiency of HVAC system and building overall energy consumption patterns. Our preliminary results based on real data traces help quantify the significant improvement, both in terms of improving the efficiency of HVAC system and reducing the building energy footprint.

Categories and Subject Descriptors

H.5.0 [**Information Interfaces and Presentation**]: General

Keywords

Energy, HVAC, Heat Loss, Green Building, Pervasive Sensing, Context

1. INTRODUCTION

Building structure, openings and leakages have direct effect on the heating and cooling of homes. Often it has been found that the utility bill is exorbitantly high. Maryland has one of the highest bills in USA [1], where in Maryland average consumption was about $140. Typically utility costs go up in winter and mostly during bouts of bitter cold when more people are likely to stay indoors. Times like the winter storm which disrupted may result in families to stay indoors for more number of days resulting an increase in consumption. As such proper heating in the house is a requisite

and minimizing the heat loss is necessary to reduce utility bills.
Motivate more

Temperature varies within a house. It is possible for bigger houses with multiple floors to have stark differences in temperature in various parts this is primarily because of faulty ducts which distribute the heat, poor insulation, infiltration which may be because of any opening and improper sealing which may cause, dirty air filter that restricts airflow, not letting home get enough hot/cool air, open windows through which conditioned air can flow out leaving uneven temperatures in the home.

Open windows are one of the big reasons for improper heating or cooling. Open windows mean that heaters or air-conditioners run for longer times hence increasing resulting in bigger bills. Deploying door sensors are a good way of finding out whether doors or windows are opened or not, but it increases the deployment cost.

In this paper we propose a method of detecting open doors or windows or possible wall openings using infrared camera (IR camera). The advantage of a IR camera is that it can monitor continuously temperature of any surface.

The outline of the work is as follows -

- **Heat Loss model:** Creating a heat loss/gain model for rooms and buildings based on the internal and external temperatures, and number of windows and doors openings.

- **Heat-model and energy relation:** Find a relation between energy consumption of heaters/coolers and the building heat loss/gain model.

- **Energy to Heat loss/gain model:** Use energy consumption of HVAC/heaters/coolers of unseen rooms/buildings to find their heat model.

2. METHOD

- Deploy temperature sensors/IR camera in rooms to come across a heating model.

- Check heater cycles and temperature.

3. CURRENT CHALLENGES

This sections are detailed problems being encountered. It is not going to be a part of draft rather a note on the recent updates.

- Battery drains from multisensors if polling rate is even per minute basis(Which can motivate IR usage) . Although this is for ground truth purposes its causing a bit of a problem with connectivity when the hub is downstairs.

- IR camera yet doesn't have the rotating feature. Hence has to be fixed. As such it neither has a proper stand which can be used.

- IR Calibration is a problem and it has to be done manually.

- IR camera needs a windows machine it will be better to get a rasp pi along with it. Recent IOT version of windows 10 has a rasp pi version which I have to try out yet.

4. REFERENCES

[1] EIA 2014
http://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf, 2014.