Dear editor:

Enclosed for your consideration is the answers for the reviewers’ comments of our manuscript, entitled "Artificial intelligence assisted heating ventilation and air conditioning control and the unmet demand for sensors: Part 2. prior information notice (PIN) sensor design and simulation results". The authors of this manuscript are Chin-Chi Cheng and Dasheng Lee. The revised version according to the reviewers’ comments is attached. Several English corrections are modified also.

Thank you very much for considering this article for your Journal.

Sincerely

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Reviewer 2:
1. Paper refers to PART 1 and PART 3 ... it is rare that you mention unpublished material. It is difficult to see the complete picture without seem all the material.

Answer: Following the reviewer’s comment, the paragraph explaining Part 3 has been revised as future work in the conclusions. The first paragraph in the introduction has been revised as following:

1. Introduction

This study continues the hypothesis proposed in Part 1 [1] that AI assisted HVAC control is a method of using predication to control and improve overall performance. However, due to the degree of prediction uncertainty being higher than that of a sensor, the capability to control system performance through this method has been limited. If there was a way to effectively improve prediction accuracies, the overall HVAC control performance could be improved. As far as the effect on energy savings is concerned, AI assisted control reached an energy savings of 57% and 44.64% compared to On-Off and PID control, respectively. Based on the above theoretically estimated results, an experimental case was selected to install an innovative sensor and calculate energy savings through simulation. The results were then compared with the theoretical estimation results. These are the main targets of this study, which discusses the sensor design and simulation results.

2. The paper is not so clear and should be partially rewritten.

Some examples:
“206 The control model shown in Figure 3 ....”
I cannot see any control model .... In figure 3
You should clarify equation (5)

Answer: Following the reviewer’s comment, line 206 has been modified as “The test site simulation shown in Figure 3 can be expressed by the following formula:’’. The first part of equation (5) describes the real-time thermal mass change caused by pedestrian movement, and the second and third parts describes the heat transmitting through the thermal resistance (wall) and air movement, respectively, from the outside temperature and humidity. The sixth paragraph of section 4 has been modified as following:

4. Simulation model and applied tools

The first part of equation (5) describes the real-time thermal mass change caused by pedestrian movement, the second and third parts describes the heat transmitting through the thermal resistance (wall) and air movement, respectively, from the outside temperature and humidity. Based on equation (5), temperature T1~T16 and relative humidity RH1~RH16 predicted by AI are able to calculate the heat flux needed for air conditioning system. That enables a model based predictive control and the energy consumption $E_{pred}$ can be calculated by

$$E_{pred}(t) = 3.5 \cdot q'(t)/\text{Average}(\text{COP}_{\text{Chiller1}}, ..., \text{COP}_{\text{Chiller6}})$$

where COP with respect to every chiller is directly measured on line and the coefficient 3.5 is used to convert the unit RT to kW value [6][7]. During the simulation, the COP also varies with the outside temperature and humidity.

3. “219 The basis of the PIN sensor design is that the daily collected sensor output data can be efficiently converted to trend and frequency.”
You should clearly specify what do you mean by trend and frequency
Why don't you implement digitally all the operations ? ....

Answer: Following the reviewer’s comment, the sensor output signal contains the DC and AC information. The DC information will be acquired by the trend filter, and the AC information will be filtered out by the frequency acquiring circuit. This explanation has been presented in the fourth paragraph of section 3. The digitized signal output is not able to trace these two facts. The second paragraph of section 5.1 has been...
5.1. Big data collection

Between 2012 and 2017, a total of 630,072,000 data was collected to design the PIN sensor and verify AI assisted HVAC control performance. Figure 4 (a) shows the temperature sensor data at 1F lobby of the test site location in one day of 2012.

The basis of the PIN sensor design is that the daily collected sensor output data can be efficiently converted to trend and frequency, which are the DC and AC components of sensor output data. According to the variation of trend, the collected sensor output data can be divided into 6 segments, as shown in Figure 4 (b)-(h). After further analysis of each segment, the trend and frequency response of sensor output data have close relationship, which is the design basis of the PIN sensor. Matlab Simulink is utilized to design the analog and digital circuitry, and verify whether or not the designed circuit can convert the sensor output signal to segment length time, trend and frequency.