Improving Building Energy Efficiency by Kinect-based Occupancy Tracking and Mobility Detecting System

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ABSTRACT

Nowadays, most building air conditioning systems still operate on a fixed schedule rather than real-time occupancy. In our study, we make an occupancy tracking software based on Kinect to reflect the number of people in a open lab. We then build a Markov Chain (MC) model after dividing the open area into 4 zones and calculating its occupancy respectively. When applying the real-time schedule of one week to a building model created with eQuest, we obtain a 22.1% energy reduction in space cooling.

1. INTRODUCTION

A 2009 report by the United Nations Environment Program (UNEP SBCI) [1] has clearly stated that construction buildings should be responsible for a significant amount of global energy consumption and greenhouse gas emissions in both developing and developed countries. At the core of energy consumption is Heating Ventilation and Air Conditioning (HVAC) systems which are designed to operate at full capacity most of the time because it's often assumed a maximum occupancy in those buildings. Although current HVAC systems are equipped with sensors, their management and control systems ignore the dynamic nature occupancy patterns in buildings. In addition, they are unable to proactively adjust to occupants' comfort levels. Understanding human mobility and occupancy patterns are key factors in successfully managing HVAC systems in buildings. Several approaches using building occupancy data to improve prediction and simulation of HVAC control have been proposed. In the same perspective, the main contribution of our paper is to propose an energy-saving model based on occupancy patterns of human mobility in buildings. This model offers a solution for the management and control of HVAC systems in smart buildings. The most important features of the system are as follows:

1. The *real-time detection and tracking of human mobility* in open lab provides accurate occupancy data of an entire floor divided into 4 zones.

2. A *occupancy counting software* carries out the detection, tracking and monitoring process based on multiple Microsoft Kinect for Windows (K4W) sensors distributed in key locations in the building.

3. A *occupancy prediction mechanism* of the building is introduced through the use of a MC which models the collected occupancy data. MC is a suitable because it captures the temporary nature of occupancy variation along with inter-room correlations. Unlike most other building occupancy techniques described in **??**, our approach is Kinect-based and therefore could report live building occupancy states after conducting simple calculations, which is also on-line.

2. IMPLEMENTATION

3. RESULTS

4. RELATED WORKS

5. CONCLUSION AND FUTURE WORK

6. REFERENCES

[1] Chuang Wang, Da Yan, and Yi Jiang. A novel approach for building occupancy simulation. *Building Simulation*, 4(2):149–167, 2011.