Multimodal Sensing for Thermal Comfort and Energy Saving in Smart Buildings

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Keywords: *(Thermal Comfort Sensing, Metabolism Measurements, Personalized Ventilation)*

Abstract

Thermal comfort control and energy saving in smart buildings have attracted much attention today. However, thermal comfort varies from person to person and also changes with climatic variations or acclimation. In addition, thermal comfort in transient conditions are different from the steady state conditions, which makes the prediction of thermal comfort more difficult. To satisfy individuals thermal comfort needs, personalized ventilation can be used to control individual person's surrounding environment in order to optimize thermal comfort for everyone with minimal energy consumption. This is especially applicable in modern dense office buildings. However, one of the key issues in thermal comfort control is how to detect each person's thermal sensation, and according to measured thermal sensation to automatically adjust the environment. This requires an effective sensing technique and model that can measure and predict the thermal comfort of individuals. With the development of Internet of Things (IoT), novel thermal comfort sensing techniques for smart buildings receive more and more attention. Utilizing IoT, modeling and analyzing personalized thermal comfort becomes possible. Therefore, a personalized comfort model maybe established for intelligent control system in smart buildings. To do that, real-time measurements of human comfort is crucial. In this talk, the author will present a personalized comfort sensing system and implement the system with a wireless communication system that can be facilitated with IoT. The proposed personalized comfort sensing system would record personal comfort region based on modified Predicted Mean Vote (PMV) formula and automatically provide a personalized comfort environment for user. The system is composed of sensor nodes and a thermal comfort monitoring and control center. Each sensor node comprises a temperature sensor, a humidity sensor, a novel metabolic sensor and wireless communication module. A novel model for measuring human metabolic rate effectively and economically has been developed utilizing the heart rate, skin impedance and heat loss sensors. The thermal comfort monitoring and control system can be integrated into a smart watch like device. This system is of great significance in automation comfort environment control for smart building, to implement a real smart building.