ABSTRACT

The energy consumption of the building industry represents the world's largest amongst other sectors such as transport, industry, and power. This consumption estimate is expected to grow as the human population increases and becomes more urbanized. To curb this growing menace, several agencies and national associations have identified the potentials of Energy Informatics (EI) solutions for enabling smart buildings. One key factor that influences the performance of buildings is the energy impact of occupant behaviors. Studies have shown that these behaviors can impact the energy profiles of buildings by up to 40% and can vary the energy profile of similar buildings by 200-300%. We identified five resolutions of occupant behaviors which can be categorized into non-adaptive occupant behaviors and adaptive occupant behaviors. In this thesis, we propose and develop methods for estimating non-adaptive occupant behaviors in buildings. Also, given that the data gathered about people occupying buildings can reveal very private and sensitive information about them, we propose and develop methods for protecting the privacy of occupants in building-related datasets.

The first step for estimating an occupant behavior in a building involves a selection process for identifying the resolutions of the behavior and the sensing modality for acquiring data about the behavior. However, several modalities have their inherent sensing challenges. Given these challenges, we propose and develop methods for mitigating them, for correcting their resulting errors and for estimating the selected behavior. In this thesis, we present two methods - PLCount and PreCount for correcting count errors and for estimating occupancy counts in buildings. In Chapter 4, we propose and develop two methods for predicting occupancy presence and counts. In Chapter 5, we propose and develop two additional multi-modal methods requiring accurate building level sensors and less accurate room level sensors for estimating occupancy counts at subspace and room levels. Lastly, in Chapter 6, we propose and develop a Privacy Preserving Data Publishing (PPDP) framework - PAD for protecting the sensitive data of occupants from potential adversaries and for improving the utility of published occupancy datasets.