

# **Autonomous Building Occupancy Monitoring using Mobile Robots**

**Hafiz Oyediran<sup>1</sup>, Matthew Peavy<sup>2</sup>, Kyungki Kim<sup>\*3</sup>**

<sup>1</sup> Ph.D. Student, Durham School of Architectural Engineering and Construction, University of Nebraska-Lincoln, U.S.A., E-mail: [hoyediran2@huskers.unl.edu](mailto:hoyediran2@huskers.unl.edu)

<sup>2</sup> Post-Doctoral Associate, Durham School of Architectural Engineering and Construction, University of Nebraska-Lincoln, U.S.A., E-mail: [matt.peavy@unl.edu](mailto:matt.peavy@unl.edu)

<sup>3\*</sup> Assistant Professor, Durham School of Architectural Engineering and Construction, University of Nebraska-Lincoln, U.S.A., E-mail: [kkim13@unl.edu](mailto:kkim13@unl.edu)

## **ABSTRACT**

Operation and maintenance (O&M) of building indoor spaces involves various tasks including occupancy monitoring. Occupancy monitoring is an important task in O&M of large buildings that impacts other tasks, such as heating and cooling control and security control within the building. Despite the importance, existing approaches for occupancy detection using static sensors have several limitations, such as the need to install many sensors to allow a thorough observation of the entire building and poor performances of the sensors not adaptive to dynamically changing conditions caused by dynamic placements and movements of objects. On the other hand, mobile robots with autonomous navigation, sensing, and perception capabilities have the potential to overcome these limitations. This study presents a method of using mobile robots for automated occupancy monitoring as an example of O&M tasks. In this study, a mobile robot autonomously navigates to target locations to detect and count the number of occupants based on the sensor data collected from a camera. The proposed approach was tested in a simulated environment of an educational facility with predefined occupancy requirements for classrooms and offices. The results demonstrate the potential of mobile robots in dramatically reducing the number of static sensors and further enhancing the performance of occupancy monitoring in large buildings. Even though this study simply checks the compliance to occupancy limits, accurate occupancy monitoring can provide crucial input for other O&M tasks like air-conditioning and lighting control.