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Continuous Monitoring of Indoor Environmental Quality using an Arduino-based Data Acquisition System

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Abstract

Building performance monitoring could be limited due to the cost and inflexibility of hardware and software platforms for data acquisition. This paper describes a portable continuous measurement toolbox which provides a robust, easily extendable, and low-cost setup for indoor environmental quality (IEQ) monitoring and performance assessment. Various sensors—temperature, relative humidity, illuminance, CO₂, VOC, PM_{2.5}, and occupancy—for IEQ performance measurement are included within this toolbox. Arduino Uno boards were connected to the sensors for data acquisition. ZigBee communication protocol was established between an XBee device for each Arduino board and an XBee receiver connected to a computer. The toolbox utilized the open source, agent-based software platform VOLTTRON for data communication and analysis. The data collection system was calibrated against an accurate data acquisition card. Experiments have been conducted using the toolbox for assessing IEQ performance in an open computer lab within a commercial building. Thermal comfort, indoor air quality, and lighting performance have been analyzed based on collected data. The study demonstrated reliability and robustness of the toolbox for continuous monitoring of indoor environmental quality.

Keywords: Indoor environmental quality, ZigBee, VOLTTRON, Wireless communication

1. Introduction

Indoor environmental quality (IEQ) covers the performance of thermal comfort, indoor air quality, lighting and acoustics for indoor environments. IEQ greatly influences an occupant's comfort, health, productivity and living quality [1]–[3]. Poor thermal comfort was identified

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