

Monitoring Indoor Air Quality and Occupancy with an IoT System: Evaluation in a Classroom Environment

Agostinho Ramos, Vagner Bom Jesus, Celestino Gonçalves, Filipe Caetano, Clara Silveira
Instituto Politécnico da Guarda, Escola Superior de Tecnologia e Gestão
Guarda, Portugal

agostinhopina095@gmail.com, vagneripg@gmail.com, celestin@ipg.pt, caetano@ipg.pt, mclara@ipg.pt

Abstract — Indoor air quality is a determining factor in maintaining occupant comfort, especially in educational environments such as classrooms. Traditional methods of monitoring indoor air quality and occupancy, such as casual inspections or periodic measurements, do not provide timely and accurate information for those who must make decisions about ventilation and controlling the number of occupants. Internet of Things (IoT) technology has opened new possibilities for monitoring and controlling indoor air quality in real time. In this paper, an IoT-based system for monitoring indoor air quality and occupancy in a classroom is presented. The system consists of low-cost sensors that collect data on temperature, humidity, dust, carbon dioxide levels and occupancy, which is then transmitted to a cloud-based platform for analysis and visualization. Evaluation of the system in a real-world classroom environment has shown its effectiveness in detecting changes in air quality and the number of occupants.

Keywords - Indoor Air Quality Monitoring, Occupancy, IoT technology, ThingsBoard platform.

I. INTRODUCTION

The lack of good air quality, both inside and outside buildings, has become a global concern. Another fact is that the general population spends approximately 90% of their lifetime inside a building [1] [2]. The degradation of air quality in this type of spaces is a known problem that results from natural environmental conditions, such as temperature and humidity variations, as well as from several existing processes [1] [3], like, for example, the several computer devices or electronic circuits that generate different types of pollutant gases that interfere with the air quality in a negative way, which can compromise the health and well-being of the people who work in those spaces [1] [2]. In this context, this paper aims to present AirVA - Indoor Air Quality Monitoring and Control with Occupants Alerting System [4], to monitor the indoor air quality continuously, also recording the entry and exit of people. It was decided to choose the agile development methodology, namely the Scrum methodology [5], because it has an approach and perspective that fits with the system to be developed.

To evaluate the prototype, tests were performed in the development environment and in some of the classrooms of a Polytechnic Institute, Figure 1, in order to verify the validity and efficiency of the system. The paper is organized into six sections. After the Introduction, comes section 2, describing the

methodology followed in the development of the project, and section 3 presenting the study of related works, some of them having similar characteristics to the proposed system. Section 4 presents the requirements, development architecture, the components used in the system and their protocols, as well as a description of the performed data management and processing, performed with emphasis on the ThingsBoard platform. In section 5 some tests and results are presented, and section 6 ends the article with the conclusions and the work that is intended to be done in the future.



Figure 1. AirVA evaluation in a classroom environment

II. METHODOLOGY

Having in mind the objective of the Indoor Air Monitoring and Occupant Counting System, it was decided to choose the agile development methodology, namely the Scrum methodology, because it has an approach and perspective that fits with the system to be developed.

Agile is a methodology where continuous interactions and testing happen throughout the software development life cycle. Among different agile methods such as Crystal Methodologies, Dynamic Software Development Method (DSDM), Feature Driven Development (FDD) and others, Scrum is among the