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Editor

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Preface

It is with great pleasure that we introduce the proceedings of the Computing Conference 2024, held on July 11 and 12, 2024. This conference served as a platform for researchers and professionals from around the globe to convene and exchange ideas at the forefront of computing and its diverse applications. The enthusiasm and dedication displayed by participants underscored the significance of this event in fostering collaboration and advancing the field.

We received an overwhelming total of 457 contributions from esteemed scholars and practitioners. These submissions underwent a rigorous double peer-review process, facilitated by experts in their respective domains. After careful evaluation and deliberation, a total of 165 papers were selected for publication in these proceedings.

The diverse array of topics covered in these papers reflects the breadth and depth of contemporary computing research, spanning areas such as artificial intelligence, machine learning, cybersecurity, data science, and beyond. Each paper represents a valuable contribution to the collective knowledge base of the computing community, offering insights, innovations, and solutions to pressing challenges.

We extend our heartfelt gratitude to all authors, reviewers, organizers, and attendees whose efforts and contributions made this conference a resounding success. It is our hope that the insights shared and connections forged during this event will continue to inspire and propel advancements in computing for years to come.

Regards,
Kohei Arai

Contents

A Intelligent environment application case to manage comfort preferences, at an university residence

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Abstract. This paper presents a novel application of intelligent environmental management within a university residence, aiming to enhance the overall well-being and satisfaction of residents by dynamically addressing their comfort preferences. The proposed system leverages cutting-edge technologies such as Internet of Things (IoT) sensors, machine learning algorithms, and smart devices to create an adaptive and responsive living environment. Through real-time data collection and analysis, the system learns individual and collective comfort patterns, allowing for personalized adjustments to temperature, and other environmental factors.

The study focuses on the development and implementation of the intelligent environment application, emphasizing user-centric design and seamless integration into daily life. Residents are empowered to set and modify their comfort preferences through a user-friendly interface, while the system continuously refines its understanding of these preferences over time. Additionally, the application considers energy efficiency and sustainability, contributing to a greener and more resource-conscious university residence.

The paper discusses the technical architecture of the intelligent environment application, including the deployment of sensors, data processing pipelines, and the communication infrastructure. Furthermore, it addresses privacy concerns by outlining robust security measures and anonymization techniques to protect user data.

In conclusion, this paper contributes to the growing body of research on intelligent environments by showcasing a practical application tailored to university residence settings. The presented system not only prioritizes resident comfort but also aligns with the broader goals of sustainability and resource optimization, making it a valuable addition to smart living solutions in educational institutions.

Keywords: intelligent-environment, AmI, comfort-preferences, IoT, sustainability

1 Introduction

In the dynamic landscape of modern living, the fusion of technology and everyday environments has paved the way for intelligent systems designed to enhance the quality of life. As universities strive to create holistic and conducive learning environments for their students, the role of technology in shaping the residential experience becomes increasingly pivotal. This paper delves into a case study focused on the development and implementation of an intelligent environment application tailored specifically for a university residence. The primary objective is to address and optimize the diverse comfort preferences of residents through the seamless integration of smart technologies [12].

University residences serve as microcosms of communal living, where the well-being and satisfaction of residents are paramount. Recognizing the multifaceted nature of individual preferences for temperature, and other environmental factors, our intelligent environment application leverages state-of-the-art technologies, such as Internet of Things (IoT) sensors and machine learning algorithms, to create an adaptive and responsive living space [6] [3] [4].

This introduction outlines the growing importance of intelligent environments in residential settings, with a particular focus on university residences as unique ecosystems. It highlights the significance of understanding and catering to individual comfort preferences, as well the potential impact on overall satisfaction, academic performance, and the development of a community sense within the residence [14].

As we navigate the intricate interplay between technology and the human experience, the subsequent sections of this paper will delve into the technical architecture of the intelligent environment application, the user-centric design considerations, and the outcomes of a pilot study conducted within a university residence. Through this exploration, we aim to contribute valuable insights into the practical application of intelligent systems in optimizing comfort preferences, thereby shaping a more responsive and personalized living environment within the university residence context [1] [2].

2 Materials and Methods

2.1 Contextualization

The building in question is a residence with 3 floors, and 5 mixed bedrooms. Each floor has a hall, that gives the access to he rooms at each floor. As a heating system, it has electric radiators, with individual control, normally having one radiator per room, and in some rooms there are two radiators.

To get an example and the perception of the space, the typical room example can be seen in figure 1.

Fig. 1: Room example.

There are also public spaces, such as halls, and a room used for leisure that are accessible by any of the residents.

2.2 Devices

Thus, actuators were installed in each of the radiators that allow them to be controlled, that is, to activate and deactivate each of the radiators, for this purpose the equipment show in figure 2 was used.

To control the presence and temperature of each room, a type of sensor was used that at the same time controls the presence and temperature of the space. The sensor can be seen in figure 3.

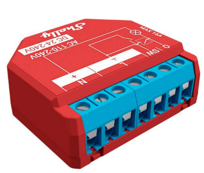

Fig. 2: Actuator module.

Fig. 3: Temperature/motion sensor.

2.3 Scenario preparation

It was necessary to prepare the space, namely installing the actuators on each of the radiators, as well a temperature/motion sensor in each of the rooms. In this way, we are aware of the occupancy of the rooms, their current temperature, and can activate whenever necessary, turning the radiators on/off independently and according to needs.

The figure 4 shows the installation of a radiator, and the figure 5 shows the installation of a sensor.

Fig. 4: Actuator installation.

Fig. 5: Sensor installation.

2.4 Assumptions

The objective is above all to maximize the thermal comfort of the residence's users, but also to optimize energy consumption, which is significant in the region. This is a region with a very hard winter and long periods of negative temperatures [17].

Therefore, the consumption to ensure thermal comfort in the building is significant. And they have to be somehow controlled. To avoid financial waste, as well considering the energy sustainability [7] [8].

2.5 Proposed solution

To achieve the objective of improving consumption, we had different situations and specificities that had to be overcome. This mainly involved analytical capacity in the search for solutions [9].

For example, regarding the common spaces, such as halls and lounges, there was also a need to carry out management that would allow consumption to be optimized, especially given that these spaces are characterized by being empty for a significant period of time of the day, as well at night. But on the other hand, there are also many periods of high mobility for different users, which makes it difficult to define a logic that also optimizes this type of spaces [10].

This difficulty was mainly because we did not want to increase the costs of the solution, with the use of additional temperature/motion sensors for these spaces, as considered their high mobility, namely because they are passage spaces, measuring presence would not be an added value at all, and would therefore not add anything relevant to the solution.

Not having temperature information in these spaces would make it impossible to continuously adjust the heating in these areas. So for the halls, as these were small spaces, which gave access to the rooms on each floor, as described in section 2.1, we opt to use the rooms (presence/temperature) information, and extrapolate this information to the values to be applied at the hall actuators. So for temperature (a weighted average of the temperature values in the rooms is used.

And for presence, we consider whenever one of the rooms is occupied, that is, we will always act, except when both rooms do not have any presence. With this approach we achieved a significant reduction in material costs, while maintaining the optimizations of comfort and energy performance, which this project proposes. Regarding leisure spaces (living rooms), the solution involved another approach as these spaces are common to the entire building, and not to some rooms [11] [18].

Here too, the solution involved an imaginative approach, which once again allowed control of implementation costs. Thus, for temperature, we used a weighted average of the values referring to the floor, where the common space is located, for presence we will consider the presence in the last four hours in any of the rooms. Therefore, whenever this fact is confirmed, we will maintain the room with comfortable conditions. We will also consider night periods, which is where we can significantly optimize consumption [15] [16].

3 Results analysis

The results so far are quite satisfactory, as we had very significant consumption values for the same periods of the previous year. So for this year, after implementation we expected significant improvements, considering the different points of intervention/optimization.

Thus, for the first two months analyzed (October and November), we already achieved values in the order of 30% reduction in consumption, compared to the same period of the previous year. This is even more relevant when the months with the highest expected consumption will be December and January, as they tend to be colder months.

Therefore, optimizations in these periods are expected to be even more significant. To all this, we associate the extremely positive feedback from users, which makes the proposed solution viable, in terms of thermal comfort and practicality of the solution.

At figure 6 and 7, we can see the charts for a specific room, to a specific period of 24 hours.

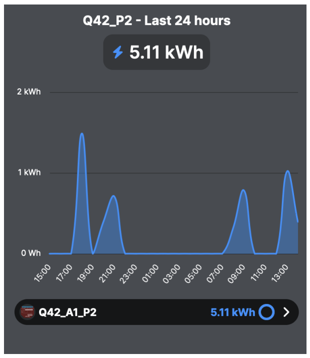

Fig. 6: Consumption example

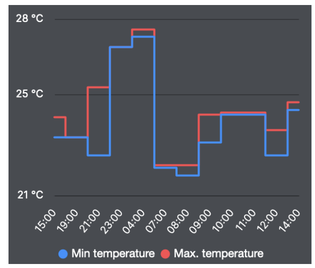

Fig. 7: Temperature example

At figure 8, we can see the chart which combines consumption and temperature, for a specific room, and to a specific period of 24 hours.

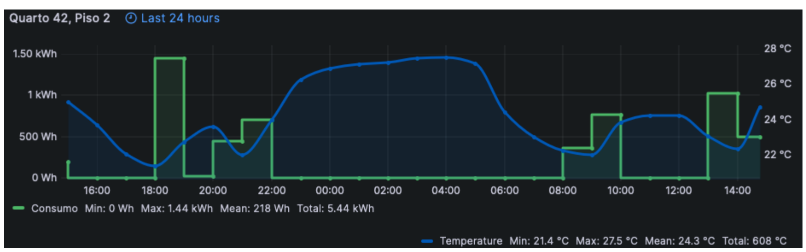

Fig. 8: Temperature and motion sensor.

4 Conclusions

In the ever-evolving landscape of smart living solutions, our exploration of an intelligent environment application tailored to managing comfort preferences within a university residence underscores the transformative potential of technology in enhancing residential experiences [13].

Through a comprehensive examination of the technical architecture, user-centric design considerations, and the outcomes of a pilot study, we have gleaned valuable insights into the practical implications and benefits of such a system.

Our findings reveal that an intelligent environment application, fueled by real-time data, machine learning algorithms, and user feedback, has the capacity to create a personalized, responsive, and adaptive living space.

By dynamically adjusting environmental factors such as temperature in accordance with individual preferences, the system contributes not only to heightened resident satisfaction but also to a sense of empowerment and control over one's living environment [5].

The user-centric design of the application ensures accessibility and ease of use, emphasizing the importance of incorporating resident input in shaping the technology that directly influences their daily lives. Moreover, our attention to privacy and security measures addresses concerns inherent to the integration of intelligent systems, fostering trust among residents and stakeholders.

The pilot study within a university residence setting has provided encouraging evidence of the positive impact of our intelligent environment application. Residents reported increased satisfaction with their living conditions, and preliminary data indicate potential energy efficiency gains. These outcomes align with broader institutional goals of fostering a positive, sustainable, and technologically advanced residential community.

Looking ahead, the intelligent environment application presented in this study serves as a testament to the possibilities of harmonizing technology with the intricacies of communal living. As we envision the future of university residences, we anticipate further advancements in intelligent systems, driven by ongoing research, user feedback, and evolving technologies.

The integration of such systems has the potential not only to optimize comfort preferences but also to contribute to a more sustainable and interconnected living environment for the academic community. This paper, therefore, stands as a stepping stone in the exploration of intelligent environments within educational institutions, offering a blueprint for the integration of technology in creating smarter, more responsive, and ultimately more satisfying university residences.

As future work, we hope to enter the so-called predictive comfort, that is, predicting the presence of users and acting in advance, so that upon their arrival the space/environment is already in the expected optimal comfort conditions.

Also in terms of consumption, this can be further reduced if we consider the consumption values in different periods of the day (bi-hourly), as these periods typically have a lower value per KW of energy, in the order of 50% . We can therefore make adjustments so that consumption is preferably in periods when the tariff value is lower. And so the value of the invoice will suffer an unprecedented reduction, which would not be possible otherwise.

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