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DEVELOPING AN EEG-BASED BUILDING MANAGEMENT SYSTEM TO ENHANCE BUILT ENVIRONMENT ACCESSIBILITY FOR DISABLED USERS

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Abstract

Nowadays, research on improving built environment accessibility have a significant effect on occupants daily life, especially for disable occupants. The existing smart building facility smart control solutions enhance the built environment accessibility, however, fail to consider the disables. In this regards, electroencephalogram (EEG) technology is raised up to provide specific care for the disables. It involves a Brain-Computer Interface (BCI) which processes the data received from an enhanced or wired brain and sends signals to external devices. This paper proposes an adapted framework to enhance the capabilities of the multidimensional building information model integrated knowledge-based building management system for disabled users. This conceptual framework is established through reviewing the existing applications of smart built environment accessibility concerning EEG, BIM and building automation technology, respectively. This research identifies the significance and feasibility of proposing an EEG-based Building Management System (EBMS).

Keywords: Electroencephalography (EEG); Building Information Modelling (BIM); EEG-based Building Management System (EBMS); Smart Accessibility

1. Introduction

Enhancing built environment accessibility is an open research objective offering a significant impact on building users' daily life [1], especially for disables. Involving cut-edge techniques such as Virtual Reality (VR), Building Information Modelling (BIM), Building Management System (BMS) in facilitating building accessibility becomes a trend in smart building establishment. However, rare research focuses on developing the smart buildings for disables. Therefore, this research proposes to developing a smart building system to enhance built environment accessibility for disabled users.

2. Literature Review

The use of standard Graphical User Interface (GUI) for current smart building facility control platforms aims to enhance built environment accessibility yet it is challenging for many disabled users [2]. Conventional VR interfaces still need more complex manipulation in Human-Computer Interaction (HCI), and physical features that non-disabled people are accustomed to can present serious problems for the disabled. A number of smart buildings currently support increased accessibility by integrating almost all the operations within a smartphone. However, it is a tough challenge for anyone with arm amputations. The application of EEG has the remarkable potential to enhance the accessibility of smart, personalized systems for amputees

[3]. EEG technology depends on a Brain-Computer Interface (BCI), which processes the data received from an enhanced or wired brain and sends signals to external devices. Such a friendly interface eliminates the dependence on finger operations.

3. Research Methods

This research adopted principles of grounded theory to develop the proposed framework. Based on the results, a functional modeling for the proposed system was conducted. In the course of this analysis, this study demonstrated that by the adoption of EEG techniques, the existing building management system can be applied for facilitating the building accessibility for disables.

4. Analysis & Results

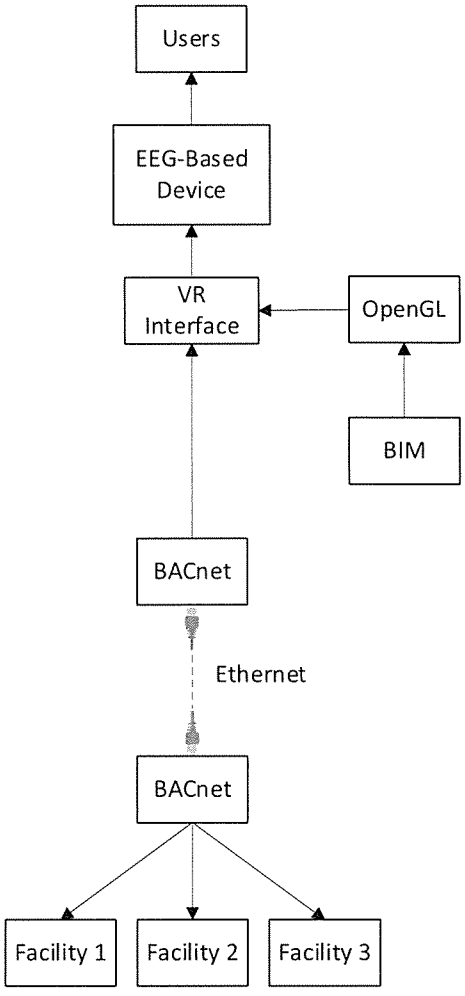

Figure 1 The Proposed Framework

This paper proposed an updated framework to enhance the HCI capabilities of multidimensional building information model integrated knowledge-based building management system (nD BIM-IKBMS) [4] for disabled users through utilizing EEG headsets. This conceptual framework was established through reviewing the existing applications of smart built environment accessibility concerning EEG, BIM and building automation technology, respectively. This research identified the significance and feasibility of proposing an EEG-based Building Management System (EBMS). (See **Figure 1**)

5. Discussion & Conclusion

Emerging in VR environments, a user-friendly interface can facilitate the recognition capacity for the disabled users. During this research, a BIM database, used for creating VR environments, was cataloged into a component-based hierarchy with multiple dimensions. Catalogued building facility information can be reasoned through simple pick operation through variable input devices, especially EEG headsets. As a bridge between users and real-world facilities, BMS is monitoring and controlling a building's facilities including: mechanical, electrical, and plumbing (MEP) systems. With the help of EEG headsets, users with certain types of disabilities can also take advantage of the proposed BMS. They are able to directly control facilities in modernized sensor-embedded houses, such as curtains, lights, HVAC, etc., by just using their brain cells [5]. Effective deployment of the proposed system is expected to enhance building accessibility, specifically for arm amputation disabled users. In the traditional system, they had to be accompanied to perform some activities of daily living (ADLs). By using the proposed system, ADLs can be carried out independently. Additionally, compared to other healthcare facilities, the cost of adopting the proposed system is affordable for the disabilities' daily use. However a

number of challenges exist, the diversity of obstacles faced by users with different disabilities makes it difficult for the proposed system to satisfy all possible users, in particular, brain dysfunction users. Normal EEG controllers have not proven effective for this group yet. Also, users of the proposed system vary with brain coverage and impedance. This divergence can have a negative impact on the accuracy of EEG sensors. Another factor that influences the adaptability of the proposed system is that individual variables in psychology can fluctuate the recording length required. Insufficient training time can reduce the trustworthiness of output data. This research anticipates future studies to focus on examining and validating the application of us the proposed system for people with a wide range of different types of disabilities.

6. References

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