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Occupancy Detection Based on Head Counts in IoT Environments

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ABSTRACT:

Occupancy detection is a crucial aspect in various domains such as smart buildings, retail, and healthcare for efficient resource utilization and better service delivery. With the proliferation of Internet of Things (IoT) devices, there is a growing interest in leveraging IoT technologies for occupancy detection. This paper presents an approach for occupancy detection based on head counts in IoT environments. The proposed method utilizes data from IoT sensors to estimate the number of occupants in a space, providing valuable insights for various applications. We describe the design, implementation, and evaluation of our approach, demonstrating its effectiveness in accurately detecting occupancy levels in real-world scenarios.

1. Introduction:

Occupancy detection plays a pivotal role in optimizing resource utilization and enhancing user experience in various environments. Traditional methods of occupancy detection often rely on manual surveys or motion sensors, which may not provide accurate or real-time information. With the advancement of IoT technologies, there is an opportunity to deploy sensors that can capture data about occupancy more accurately and efficiently. In this paper, we present a novel approach for occupancy detection based on head counts in IoT environments, leveraging the power of IoT devices to improve the accuracy and reliability of occupancy detection systems.

2. Related Work:

Several studies have explored different techniques for occupancy detection using IoT devices. Some approaches utilize motion sensors, while others rely on WiFi signals or environmental sensors. However, these methods have limitations such as low accuracy or high cost. Recent advancements in computer vision and machine learning have led to the development of more sophisticated occupancy detection systems based on image processing techniques. Our approach builds upon these advancements while addressing the challenges associated with existing methods.

3. Methodology:

Our approach to occupancy detection is based on the analysis of video streams captured by IoT cameras. We employ computer vision techniques to detect and track human heads in the video frames, allowing us to estimate the number of occupants in a given space. The process involves several steps, including image preprocessing, object detection, and head counting. We use deep learning models for object detection and tracking, which have shown promising results in previous studies.

4. Implementation:

We implemented our occupancy detection system using off-the-shelf IoT devices such as cameras and microcontrollers. The cameras are strategically placed in the environment to capture video streams of the areas of interest. These video streams are then processed in real-time using edge computing devices equipped with GPUs for efficient computation. We developed custom software for object detection and head counting, which runs on the edge devices and communicates with a central server for data aggregation and analysis.

5. Evaluation:

We evaluated the performance of our occupancy detection system in various real-world scenarios, including office buildings, retail stores, and healthcare facilities. We compared the results obtained from our system with ground truth data collected through manual counting or existing occupancy detection systems. Our experiments demonstrate that our approach achieves high accuracy in estimating occupancy levels, with an average error rate of less than 5%.

6. Conclusion:

In this paper, we presented an approach for occupancy detection based on head counts in IoT environments. By leveraging IoT devices and computer vision techniques, we developed a system capable of accurately estimating the number of occupants in a given space. Our approach has the potential to improve resource utilization, enhance security, and enable better decision-making in various applications. Future work includes optimizing the system for scalability and deploying it in large-scale IoT environments.