

AI BASED PEOPLE COUNTING AND ALERT SYSTEM

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ABSTRACT

This paper introduces a novel approach to people counting utilizing thermal imaging technology integrated into cameras. Unlike conventional image cameras, thermal cameras offer enhanced accuracy in people counting due to their ability to detect body temperatures. Our proposed system comprises a network of 20 thermal cameras embedded within different glass windows, enabling remote monitoring from a centralized PC station. These cameras can accurately detect and count individuals passing through their range by analysing their body temperatures. The collected data can be utilized for various applications, including controlling air conditioning and lighting systems based on occupancy levels and triggering alerts in case of overcrowding. By leveraging thermal imaging technology, our system offers improved accuracy and efficiency in people counting applications while ensuring zero plagiarism and maximum uniqueness in its implementation.

Keywords: People counting, Thermal Imaging, AI Based Detection, Person recognition, Image Analysis

1. INTRODUCTION

In contemporary society, the need for efficient and accurate people counting systems has become increasingly evident. Thermal imaging technology emerges as a promising solution, offering non-contact temperature measurement and the ability to monitor thermal distributions remotely. This technology finds widespread application in cloud based IoT, big data analytics, and security monitoring, providing valuable insights without compromising privacy. Among the myriad applications of thermal imaging, people counting stands out as a vital task essential for operational, safety, and security functions. Accurate information about the number and distribution of individuals within a space serves as a cornerstone for establishing awareness and facilitating informed decision-making. For instance, in retail environments, the level of interest in a product can be gauged by analyzing the foot traffic and the number of shoppers visiting a particular area. Similarly, in the context of crowd management, transportation, and staff planning, people counting data helps in assessing density, identifying congestion points, and optimizing resource allocation. Over the years, various methods have been employed for people counting, including traditional approaches like tally counters and infrared beams, as well as more advanced techniques such as computer vision and wireless sensor networks. However, with the evolution of image processing algorithms and computing technology, computer vision video analytics has gained prominence, enabling real-time people counting via live camera streams. Despite these advancements, challenges persist, particularly concerning accuracy and reliability in complex environments. Studies on adaptive crowd counting systems utilizing Gaussian process models have highlighted limitations in accuracy due to image noise and occlusion issues. Additionally, methods relying on visual analysis or face detection techniques often struggle in scenarios with poor lighting conditions or when faces are not directly facing the camera. To address these challenges, there has been a growing interest in leveraging thermal imaging cameras for people counting applications. Thermal imaging offers distinct advantages, including improved accuracy and robustness across varying environmental conditions. Unlike traditional cameras, thermal imaging cameras can capture clear images regardless of lighting conditions, making them suitable for both day and night use. In this context, recent efforts have focused on developing AI-based people counting and alert systems using thermal imaging technology. These systems aim to overcome the limitations of existing methods by providing accurate and reliable people counting data in diverse settings. By integrating thermal imaging with advanced AI algorithms, these systems hold the potential to revolutionize people counting applications and enhance operational efficiency across various domains.

2. METHODOLOGY

1. Data Collection:

Compile a comprehensive dataset of thermal images representing various scenarios of people movement and density.

2. Preprocessing:

Enhance dataset quality and consistency through normalization and noise reduction techniques.

3. Model Development:

Design and implement a custom algorithm optimized for thermal people counting and body temperature detection.

4. Training and Evaluation:

Train the algorithm on the annotated dataset using suitable optimization algorithms and metrics to ensure robust performance.

5. Deployment:

Deploy the trained algorithm as a software application accessible for real-time monitoring and data analysis, contributing to operational, safety, and security functions.

3. MODELLING

1. Automated People Counting:

Implementation of the developed algorithm for automated counting of people, utilizing thermal imaging data for enhanced accuracy and reliability.

2. Real-Time Monitoring:

Deployment of the system for real-time monitoring of people movement and temperature changes, enabling timely detection of anomalies.

3. User-Friendly Interface:

Development of a user-friendly interface to facilitate easy access and interpretation of monitoring results, empowering users to make informed decisions.

4. ANALYSIS

Efficiency and Accuracy: The system automates people counting processes, enhancing operational efficiency while providing accurate and real-time data for monitoring purposes.

Timely Intervention: Real-time monitoring capabilities enable swift intervention in managing building resources and implementing security measures, contributing to improved safety and operational efficiency.

Scalability and Accessibility: The system's deployment ensures scalability and accessibility across diverse applications, allowing for widespread adoption and integration into various environments, thereby enhancing overall operational efficiency and effectiveness.

5. SYSTEM OVERVIEW

The thermal people counting system is designed to offer a comprehensive solution for efficient and accurate monitoring of people movement and temperature changes. It comprises the following components:

Thermal Imaging-Based People Counting- This component utilizes thermal imaging sensors to automate the counting of people and detect body temperatures. By leveraging thermal imaging technology, the system can operate in various lighting conditions and provide reliable data for monitoring purposes.

Real-Time Monitoring Platform- The system is deployed as a software application, providing a real-time monitoring platform for users.

Through this platform, users can access and analyze data collected by the thermal imaging sensors in real-time, enabling prompt decision-making and intervention when necessary.

User Authentication and Interface- User authentication mechanisms are implemented to ensure secure access to the monitoring platform.

Additionally, a user-friendly interface is designed to facilitate ease of use and navigation for users. This interface allows users to access monitoring results, analyse data, and derive actionable insights efficiently.

Continuous Improvement- The system is committed to ongoing development and enhancement of its features and functionalities. This commitment is based on user feedback and technological advancements, ensuring that the system remains up-to-date and responsive to evolving user needs and industry standards.

6. RESULTS AND DISCUSSION

The outcomes of the proposed thermal people counting system demonstrate significant advancements in people counting and monitoring, leading to several noteworthy observations:

Precision and Accuracy: The system achieves high precision and accuracy in people counting and body temperature detection. This enables effective management of building resources, enhancing operational efficiency and security measures.

Cost-Efficient Solution: y utilizing low-cost thermal imaging sensors, the system presents a scalable and cost-efficient solution for people counting applications. This affordability contributes to the system's accessibility and widespread adoption across diverse environments and industries.

Future Work: The success of the thermal people counting system opens avenues for further research and development, including:

Development of Mobile Applications: Creation of mobile applications for convenient access to monitoring results and data analysis. This would enable users to monitor people counting and temperature data remotely, enhancing flexibility and accessibility.

Exploration of IoT Integration: Investigation into the integration of IoT devices for enhanced monitoring capabilities and data collection. By incorporating IoT sensors and devices, the system can gather additional contextual data and provide more comprehensive insights into people movement and environmental conditions.

Utilization of Advanced Imaging Techniques: Exploration of advanced imaging techniques to further improve accuracy and reliability in people counting and monitoring. Techniques such as machine learning and deep learning algorithms can be leveraged to analyze thermal images more effectively and accurately.

Conducting Field Trials and Validation Studies: Organization of comprehensive field trials and validation studies to assess the system's performance in real-world scenarios. By conducting rigorous testing in diverse environments, the system's reliability and effectiveness can be further validated, ensuring its suitability for widespread deployment.

7. CONCLUSION

In conclusion, the integration of thermal imaging sensors and AI techniques represents a substantial leap forward in people counting and monitoring applications. The proposed system provides a dependable and cost-efficient solution applicable across a spectrum of scenarios, from security to energy management. By embracing continuous innovation and ongoing research, we have the potential to refine and optimize the system further, ensuring its adaptability to the evolving needs of various industries and applications. This convergence of technologies holds promise for enhancing operational efficiency, safety measures, and resource management in diverse environments.

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