Problem Statement

Creating 2D Occupancy Grid Map using overhead infrastructure cameras

Objective:

The main goal is to generate a 2D Occupancy Grid Map. This type of map provides a structured representation of an environment where each cell in a grid indicates whether it is occupied by an object (such as a person or a table), is free space, or is unknown.

Unique Idea Brief (Solution)

Camera Setup: Install overhead cameras for comprehensive room coverage.

Computer Vision: Employ advanced algorithms for real-time object detection and segmentation.

Occupancy Grid Map: Generate and update a grid-based map indicating room occupancy status.

Visualization: Provide a user-friendly interface for visualizing and analyzing occupancy data.

Benefits:

Optimized Space Usage: Facilitates efficient room layout planning and resource allocation.

Enhanced Security: Improves monitoring capabilities for enhanced safety and security measures.

Real-time Insights: Enables proactive decision-making based on current room occupancy dynamics.

Features Offered

- Real-Time Monitoring
- Object Detection and Segmentation
- Occupancy Grid Mapping
- Comprehensive Coverage
- User-Friendly Interface
- Integration Capabilities
- Data Analytics and Insights
- Scalability and Flexibility
- Security and Privacy

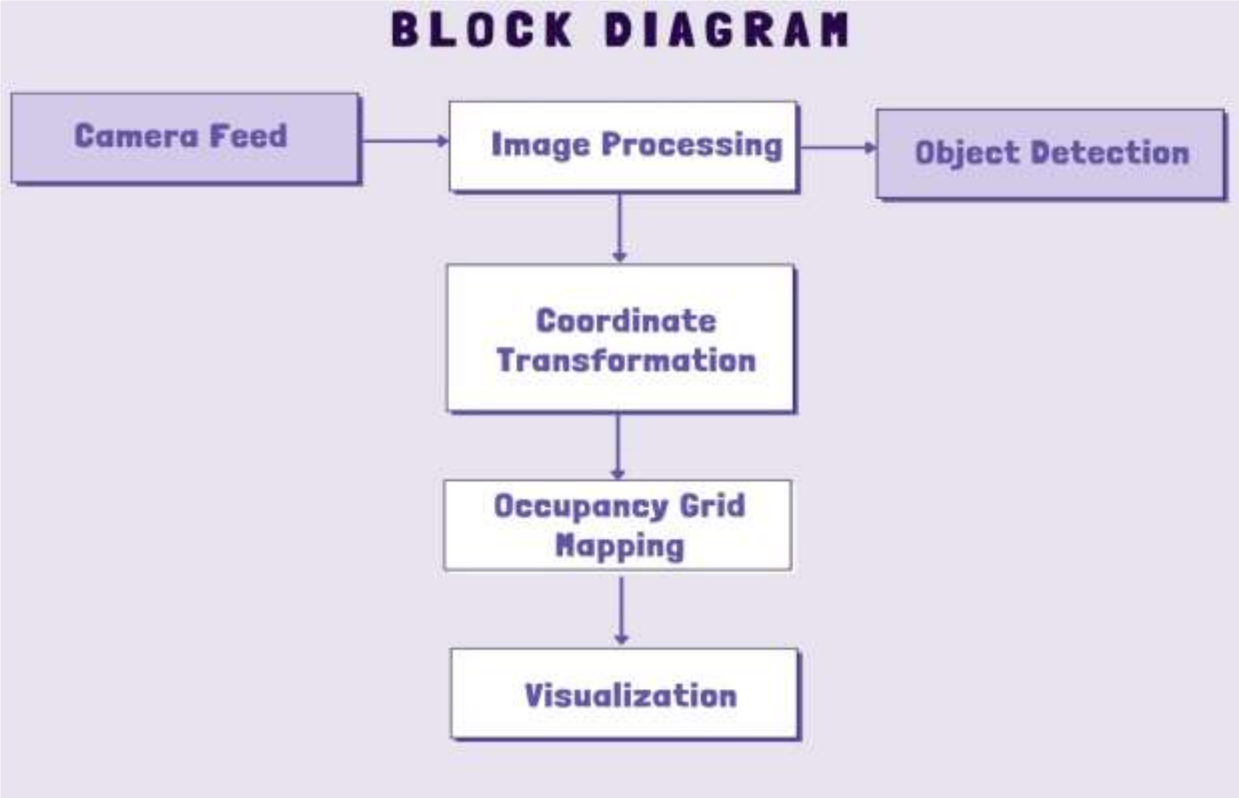
Process flow

The process flow for a Smart Room Monitoring System using overhead infrastructure cameras begins with the installation and calibration of cameras to ensure optimal coverage and accurate imaging within the room. Once installed, the cameras continuously capture images, which undergo pre-processing to enhance quality and prepare them for analysis.

Using advanced computer vision techniques, the system detects and segments objects within the room, such as people and furniture. These detected objects are then mapped onto a grid-based representation of the room's floor, where each grid cell indicates occupancy status (occupied, free, unknown).

The system constructs a real-time 2D Occupancy Grid Map, updating it dynamically as objects move or new ones enter the scene. This map is visualized through a user-friendly interface, providing stakeholders with real-time insights into room occupancy and usage patterns.

Architecture Diagram



Technologies used

Camera Technology:

Employs camera calibration software like OpenCV for precise adjustment to correct lens distortions and ensure accurate spatial mapping.

Computer Vision and Image Processing:

Leverages OpenCV for preprocessing tasks including resizing, normalization, and noise reduction to enhance image quality before analysis.

Data Processing and Analysis:

Utilizes Apache Spark or TensorFlow for analyzing historical occupancy data, extracting usage patterns, and deriving actionable insights.

User Interface and Visualization:

Deploys on scalable cloud platforms such as AWS or Google Cloud for efficient management across various room configurations.

Security and Privacy:

Adheres to data protection regulations (e.g., GDPR, CCPA) and implements best practices for secure handling of sensitive information

Team members and contribution:

ALMAAZIN M: Camera calibration(Full Project Guidence)
ABIRAJ R: 2D Grid Map Generation
KOWSHIK S : Linux administration
MOSHIKA I : Project enhancement
KAVIYA L: Git hub management and PPT

Conclusion

In conclusion, the integration of advanced technologies such as high-resolution overhead cameras, sophisticated computer vision algorithms, and robust data processing capabilities has revolutionized room monitoring systems.

Through the seamless integration with existing systems and scalable deployment on cloud platforms, the system ensures flexibility and efficiency across various room sizes and configurations. Moreover, stringent security measures and compliance with privacy regulations safeguard data integrity and user confidentiality throughout the monitoring process.