Problem Statement 10

Develop a 2D Occupancy Grid Map of a Room using Overhead Cameras

Unique Idea Brief (Solution)

The project aims to create a 2D occupancy grid map of a room using overhead cameras. By capturing images from multiple overhead cameras, processing these images to stitch them together, and then generating an accurate occupancy grid map, the system can efficiently represent the occupied and free spaces in a room. This solution can be used for various applications, including robotic navigation, space utilization analysis, and smart home systems.

Features Offered

- **Real-Time Image Capture**: Continuous capture of images from overhead cameras to provide up-to-date room occupancy information.
- **Image Stitching**: Combining images from multiple cameras to create a seamless and comprehensive view of the room.
- **Occupancy Detection**: Identifying occupied and free spaces within the room using advanced image processing techniques.
- **Grid Map Generation**: Creating a 2D grid map that accurately represents the room's occupancy status.
- **Scalability**: Ability to scale the system to larger rooms or multiple rooms by adding more cameras and processing power.

Process flow

System Setup:

- Install Ubuntu 20.04 on Windows 11 using VirtualBox.
- Set up the development environment by downloading necessary dependencies and packages for ROS and Gazebo.

Initial Simulation:

- Run a house simulation in Gazebo without overhead cameras to verify the basic setup.

Camera Integration:

- Install and configure the overhead camera Waffle Pi model file.
- Add overhead cameras to the simulation.

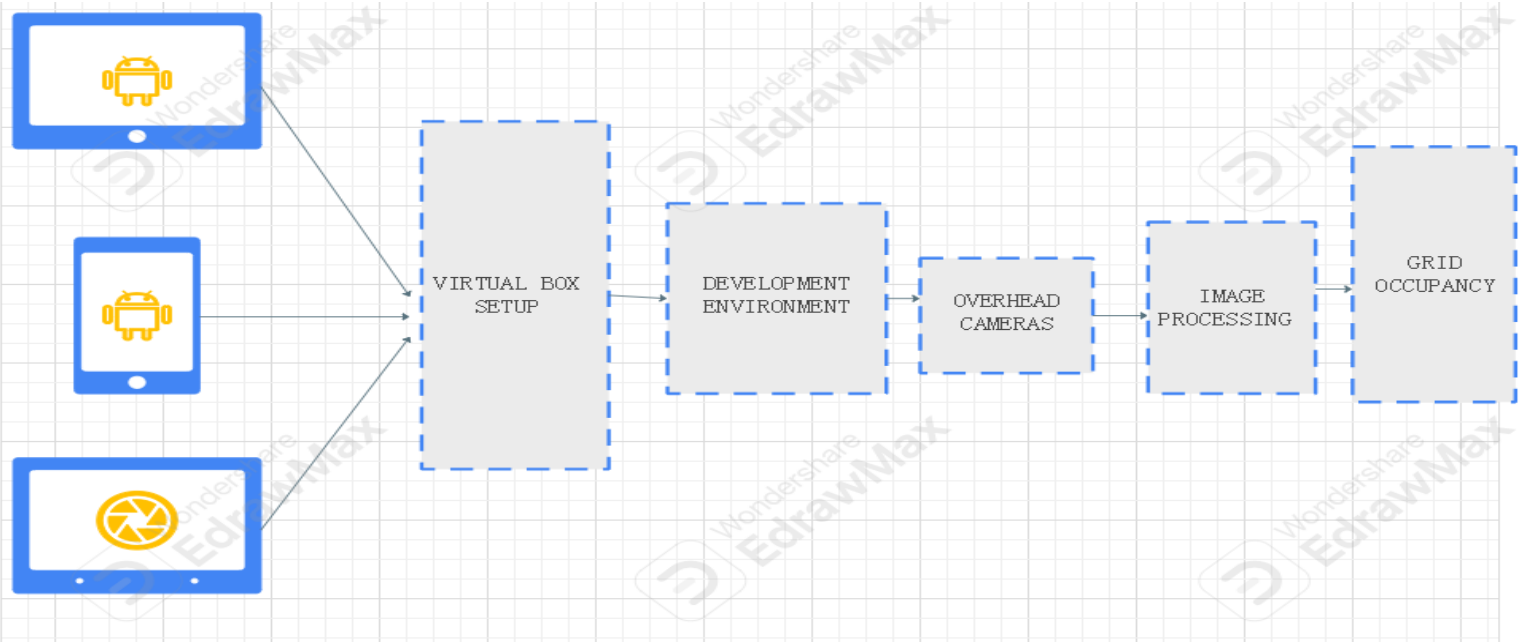
Image Capture and Processing:

- Use a Python script to capture images from the overhead cameras.
- Process and stitch the images to create a seamless view of the room.

Occupancy Grid Map Creation:

- Analyse the stitched images to detect occupied and free spaces.
- Generate a 2D occupancy grid map based on the processed images.

Architecture Diagram



Technologies Used

- Operating System: Ubuntu 20.04 on VirtualBox (Windows 11)
- Simulation Software: Gazebo
- Robot Operating System (ROS): Foxy version
- Programming Language: Python
- Hardware: Overhead cameras (simulated using Waffle Pi model)

Team members and contribution:

Team member 1:

- ✓ Set up the Ubuntu environment and installed necessary packages.
- ✓ Configured ROS and Gazebo, ran initial simulations.

Team member 2:

- ✓ Integrated overhead cameras and managed image capture.
- ✓ Developed and debugged the Python script for image processing.

Conclusion

The project successfully developed a system to create a 2D occupancy grid map of a room using overhead cameras. Despite challenges in image stitching and processing, the team effectively set up the environment and integrated the cameras. This project demonstrates the potential of using overhead cameras for real-time occupancy detection and mapping, with applications in robotics and smart home systems.