Topological Visual Navigation with Omnidirectional Camera

Student: Wong Ka Yu
Shao Tzi Yang

Supervisor: Prof. Liu Ming

Project Overview

Abstract: In this project, we aimed to build a navigation module for robots using multiple robots that can work together to map the environment and navigate through it. We utilized the omnidirectional camera to capture a wide field of view, which allowed us to build a topological map of the environment. The overall system was designed to work in a modular way, with different components handling different tasks. The main components of the system include a mapping algorithm, a navigation algorithm, and a control module. The mapping algorithm was responsible for creating a topological map of the environment, while the navigation algorithm used this map to plan a path for the robot to follow. The control module then executed the planned path, ensuring that the robot could navigate through the environment.

Methodology

We propose a method for solving the topological mapping problem using multiple robots. The basic idea is to divide the environment into a number of regions, each of which can be mapped separately. The robots then work together to map these regions and create a complete map of the environment. This method is particularly useful in large environments, where it would be impractical for a single robot to map the entire area. By using multiple robots, we can divide the task into smaller, more manageable parts, and each robot can then focus on mapping a specific region.

In order to solve the task, we use a distributed approach. Each robot is responsible for mapping a specific region of the environment. The robots then communicate with each other to exchange information about the regions they have mapped. This allows them to build a complete map of the environment, even if some regions are not visible to all of the robots. The communication between the robots is handled using a communication protocol that allows them to exchange data in a reliable and efficient manner.

The robots communicate using a distributed algorithm that ensures that each robot has a complete and accurate map of the environment. The algorithm is designed to handle situations where some robots may be temporarily unavailable or disconnected from the network. In these cases, the other robots can continue to map the environment, and the information from the disconnected robots can be recovered when they rejoin the network.

Result and Analysis

We evaluated our system using a number of experiments. The results showed that our system was able to map large environments efficiently and accurately. The robots were able to communicate with each other effectively, and the distributed algorithm allowed them to handle failures and disconnections in a robust manner. The system was also able to handle situations where some regions of the environment were not visible to all of the robots, and the information from these regions could be recovered when the robots returned to the area.

In conclusion, our system provides a scalable and flexible solution to the topological mapping problem. By using multiple robots, we can divide the task into smaller, more manageable parts, and each robot can focus on mapping a specific region. This approach is particularly useful in large environments, where it would be impractical for a single robot to map the entire area. The system was able to handle failures and disconnections, and it was able to recover information from regions that were not visible to all of the robots. The results showed that our system is a promising approach for solving the topological mapping problem using multiple robots.