EECS 467: Autonomous Robotics Design Experience — Fall 2019

ELECTRICAL ENGINEERING AND COMPUTER SCIENCE
UNIVERSITY OF MICHIGAN

AUTOM and JERRY

Team Members
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Autonomously Detect and Approach Manually Controlled Mobile Agents

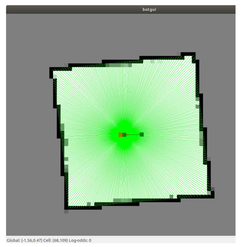
PROJECT OVERVIEW

This project is inspired by the "Push-Button Kitty" Episode from Tom & Jerry. We developed an intelligent mobile robot that can detect and approach a manually controlled moving agent.

IMPLEMENTATION

SLAM

We used Simultaneous Localization and Mapping (SLAM) to localize our robot. Our implementation relies on odometry and lidar readings.

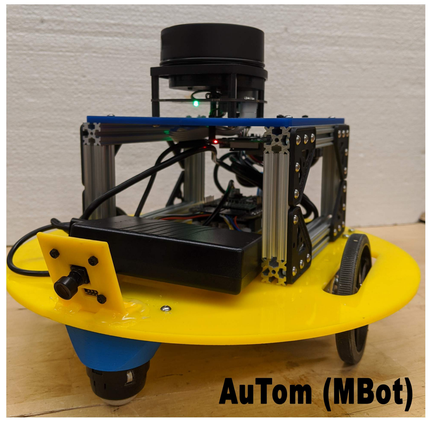


VISION

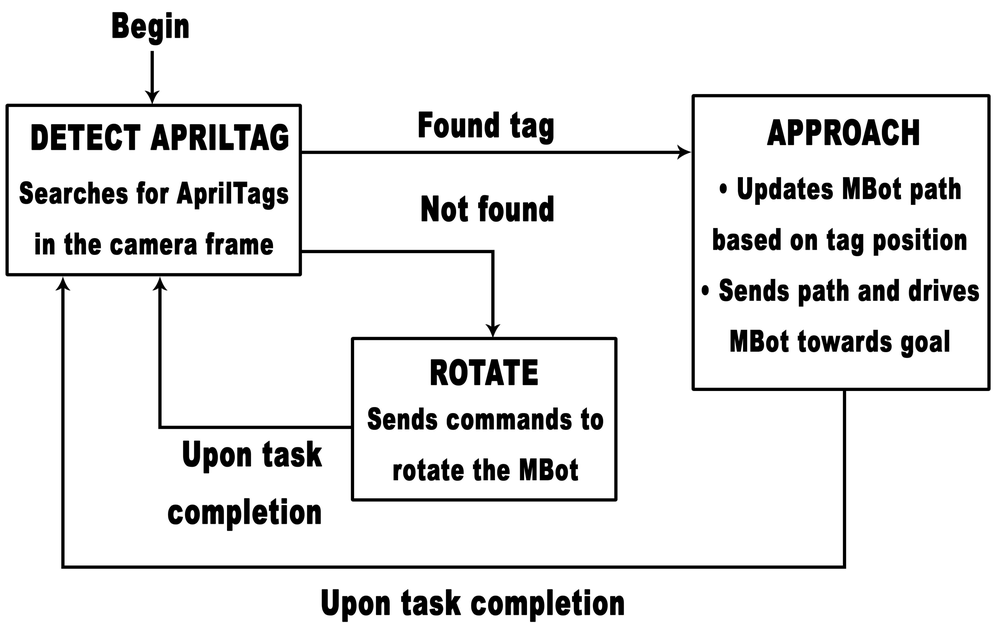
We used AprilTags and OpenCV to identify and calculate Jerry's pose relative to the cameras.

PID CONTROLLER

We tuned a critically damped controller to drive the robot to its target pose.



STATE MACHINE (SM)



FAULT-TOLERANT SM

- AprilTag detection runs on video thread
- State machines run on logic thread
- Robot commands run on task thread
- SLAM and motion planner are executed on a laptop while motion controller runs on the Pi
- Lightweight Communications and Marshalling is used to send data among the processors

COORDINATE TRANSFORMATION

- The camera perceives the physical world in the camera coordinate frame
- The robot pose is interpreted using the SLAM coordinate frame
- Homogeneous transformations are used to convert from camera to SLAM coordinates

MBOT COMPONENTS

- Raspberry Pi 3B
- Beaglebone Green
- RPLidar A2
- Camera mounts (3D printed)
- 2 x ELP 720p USB Camera Module (100 degree field of view)