ROS 기반 모바일 로봇을위한 다중 층 자율 주행 시스템 설계

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Design of Multiple Floors Autonomous Navigation System Based On ROS Enabled Mobile Robots

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ABSTRACT

In Simultaneous Localization and Mapping (SLAM), the robot acquire its map of environment while simultaneously localize itself relative to the map. Now a day, a map acquired by the mobile robots limit to specific area, in an indoor environment and cannot able to navigate autonomous between different floors. We propose a design that could able to overcome this issue in order to navigate multiple floors with one end goal mission to a target destination in the course of autonomous navigation. In this research, we consider all the floors have identical structural arrangement. Internet of Things (IoT) playing crucial role in bridging between “things” and Robot Operating System (ROS) enabled mobile robots.

키워드

SLAM, 클라우드 로보틱스, 사물의 인터넷, IoT, SLAM, 엘리베이터

Ⅰ. Introduction

Due to the advancement of technology, there has been a growing interest in mobile robots as well as autonomous vehicles. In Mobile robots, withier it’s indoor or outdoor they deal with one common problem: Navigation. The application of navigation can be categorized in to four general categories: land navigation, marine navigation, aeronautic navigation, and space navigation [1]. For example, a land navigation, Automobile that perform tasks in real world environment use GNSS (Global Navigation Satellite System) to estimate and enhance its positioning information [2]. While the in an indoor navigation relative positioning with respect to previous positions (Dead Reckoning) was considered.

In mobile robot, navigation is the essential part to navigate from starting point to destination. But to accomplish this journey from position ‘x’ to position ‘y’ and vice versa at list we need to have a map of given environment, position and orientation, sensors and route planning and path finding.

Mapping is one of the fundamental core competencies of autonomous robots [3]. Since robots can only plan a path with respect to map, there are variety different types of maps used in the given environment of mobile robots: as an example, topological maps, grid maps, maps consist of geometric beacons, etc. [4]. Being to solve and update a map from scratch can greatly reduce the efforts for later use that enable our robots to use accurate map for path planning and navigation.

Intern of things (IoT) connecting object around us to provide seamless communication and contextual service provide by them. Development of actuators, sensors, smart phone and etc. make it possible to materialize IoT which interact each other to make the service better and accessible anytime, from anywhere [6]. Soon in the future, IoT is expected to bridge diverse technology to enable new application by connecting physical object together in support intelligent decision making [7].

Placing ground mobile robot in certain environment or floor for example, our university corridor located on the 8th floor to provide service to staff members, we need to give occupancy grid map of know environment in advance. But in most of the system that already implemented using a map to navigate from one point to another within the same floor or area. So, customer can not able to get service if he/she located on different floor the service provider robot located. Appling SLAM (Simultaneous Localization and Mapping) in this field in not a new idea and is not the focus of this paper. Instead, the contribution of this paper is using a single map for multiple floor navigation that allows the robot to navigate from floor 'x' to floor 'y' with single occupancy grid map. As a result, we designed to reduce the time and computational required by hardware, software, and increase efficiency and accuracy, and expand area of to be navigate by using single map for cross floor autonomous navigation.

This paper organized as follows: we started with an introduction. Follow by Section 2, system model and methods. Section 3 concludes this article.

II. System model and methods

In this paper, targeted our research based on TurtleBot [5] is a platform that allow us to conduct our research on complex technology such as autonomous navigation at low-cost, with open-source software based on Robot Operating system (ROS). TurtleBot is originally created at willow garage by Melonee and Tully Foote in November, 2010. Among the TurtleBot generation serious, TurtleBot3 (TB3) is a new generation mobile robot which is modular, compact, extensible, customizable, and strong sensor lineups.

Creating clean map with SLAM, increase the chance to have global optimum path planning when our mobile robot navigate from current position to destination. As shown in figure 1, the master robot, which is responsible for creating overall map of the environments with the help of high computing public cloud. The remaining robot $_1$ robot $_2$ and robot $_n$ will be consider as slave and they are not responsible to create environmental map. This method allow us to reduce the additional time required to create map for each robots, use stable single map for all nth number of robot that will add to service environments.

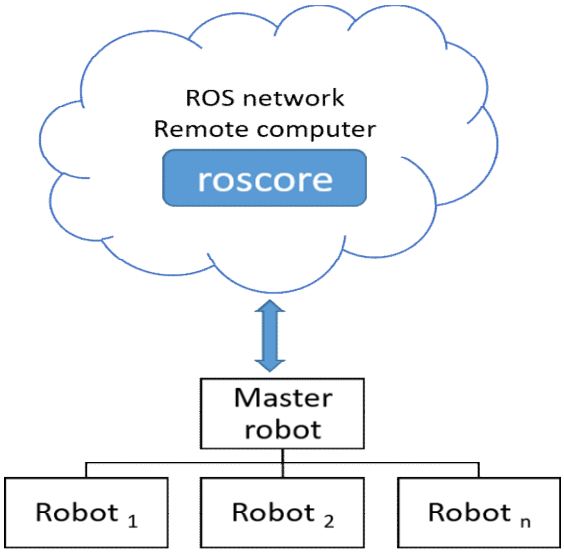

Figure 1: Overall system architecture

The master robot also update if change occurred in the environments like adding or removing big furniture on preexisting environment affect the performance of global path planning algorithm.

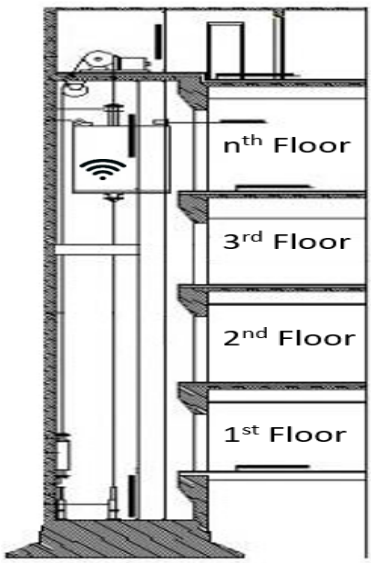

Figure 2: Design of multiple floors single map navigation approach

As shown in Figure 2, a design of multiple floors to use single map for autonomous navigation approach. In this approach we will use cloudless IoT connectivity with let our robot able to communicate with the things in the environment like elevators to let our ground mobile robot navigate from 'x' floor to 'y' floor.

III. Conclusion

In this paper, we propose design of multiple floors autonomous navigation using single map approach based on TurtleBot which is ROS enabled standard platform for ground mobile robots. Cloud-based SLAM, allows us to optimizing resource and data sharing like map of the environment, which allows us, as one of shared available online map. As result, whenever a new mobile robots added to environment the requirement of building occupancy grid map that use for path planning and navigation are avoid. So, this allow you to minimize cost of additional sensors, computational requirement by hardware and software, increase efficiency and, accuracy of map.

With the design of multiple floor autonomous navigation, which will alow ground mobile robots to navigate from ‘x’ point in the floor and ‘y’ destination in another floor. Using this approach service user can able to communicate without limit mobility to access service provided by specified robot.

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