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DEVELOPMENT AND IMPLEMENTATION OF A MULTI-AGENT SYSTEM

1. INTRODUCTION

Multi-agent system (MAS) is a collection of individual computerized machines, capable of interacting and achieving a common goal.

MAS enables robots to collectively tackle challenging tasks where individual robots are limited by individual capabilities, such as physical restrictions and resource shortages.

Robot Operating System (ROS) is an open-source software package allowing basic robotic control and communication.

2. OBJECTIVES

To develop a ROS-based software architecture for MAS that satisfies the following criteria:

- o Distributed computation
- o Autonomous control
- o Independent decision making
- o Self-localization and mapping
- o Cloud-based intelligence
- o Shared data server for improved efficiency
- o Robust scalability and modularity

The project develops a proof-of-concept experiment to prove the feasibility of the software architecture. The experiment will involve robots of different natures (ground vehicle and aerial vehicle).

3. PROJECT PLAN

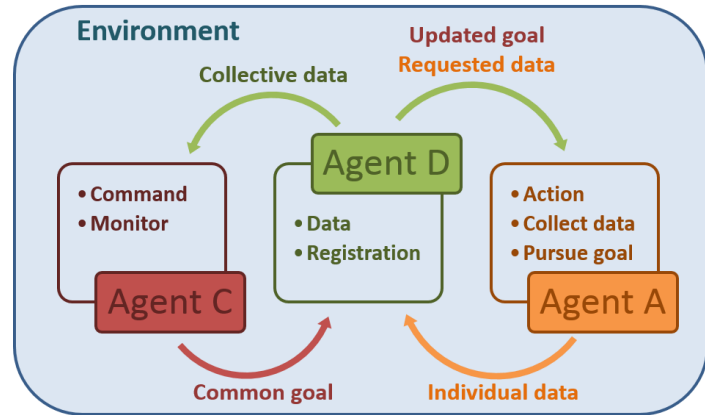
- ✓ Prepare hardware of unmanned ground vehicle (UGV)
- ✓ Prepare hardware of unmanned aerial vehicle (UAV)
- ✓ Test readiness and self localization and autonomous navigation of UGV and UAV
- ✓ Prepare ROS Multi-master communication system, data exchange server and monitor station
- ✓ Test and monitor simultaneous operations

4. AGENTS CLASSIFICATION AND INTERACTION

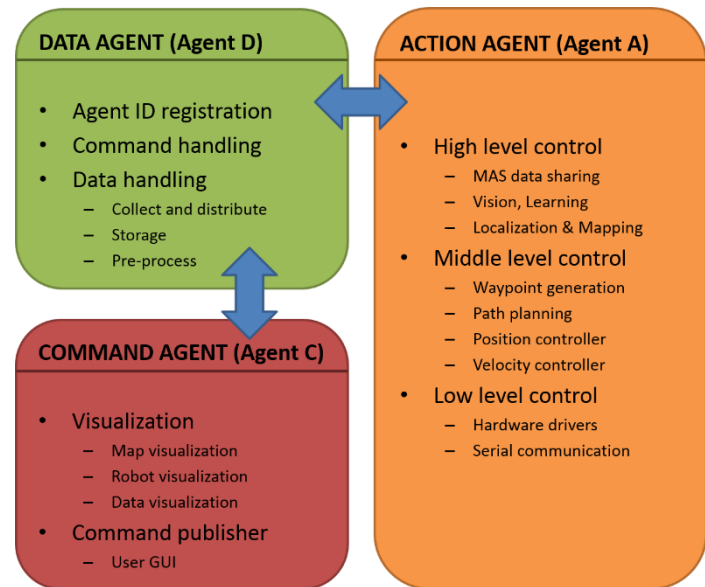
In this project, the MAS is classified into three types/roles:

- Action agent (**agent A**): capable of locomotion and physical manipulation, in charge of exploring the environment, collecting data and pursuing defined goal by self-collected data and inherited data from **agent D**.
- Data agent (**agent D**): interacting with **agent A** to collect, provide, store and pre-process data. The main purpose of pre-processing is to assist the data exchange.
- Command agent (**agent C**): interacting with **agent D** to monitor activities and statuses of other agents and give common goal for the whole system.

In practice, there are possibly multiple instances of each type of agent. Moreover, one physical platform could carry more than one agent and hence plays more than one role, such as **A&D**, or **D&C**, to fully utilize available resources



5. MAS SOFTWARE ARCHITECTURE



6. PROOF-OF-CONCEPT EXPERIMENT

The experiment, with UGV and UAV as agents A and 1 workstation as agent C&D, demonstrates the real life performance and interaction between different agents, proving the robustness of the software architecture.

