warthog robotics

@Home - Antares

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Introduction

Warthog Robotics is a traditional robotics research and extension group at the **University of São Paulo (USP)** that develops robotics technology. **Antares** is a service robot designed to contribute to the scientific and robotics community by assisting with household tasks. From a simple concept, Antares has evolved into a complex hardware and software system capable of performing tasks in the RoboCup@Home league.

Hardware

Antares' structure is composed by a **Pioneer 3-DX** as its main support, locomotion and power supply. It has a **LIDAR** and a **camera sensor**, a **LCD screen**, **external speakers**, a **microphone** and a **computer** to process and integrate the equipment's functions and environment interactions. The mechanical structure is metalon and plastic based and designed and manufactured for Antares.

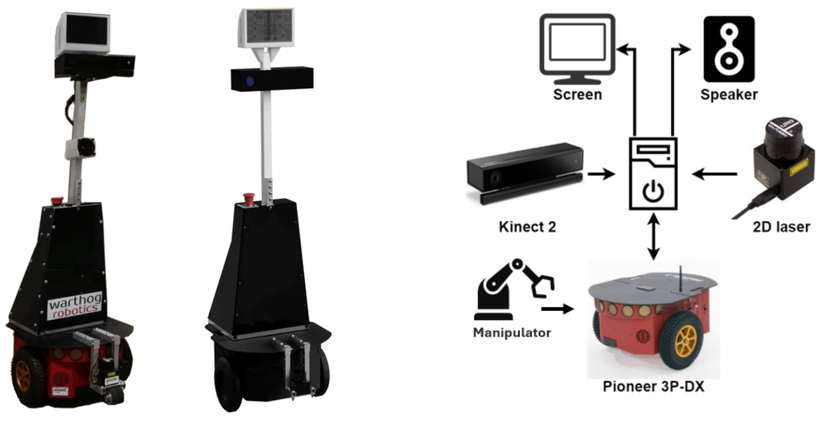

Fig. 1: Overview of Antares' hardware.

Manipulator

A major hardware innovation was the creation of a **lightweight 3-DOF manipulator** with a **reach of 70 cm** and a capacity to grasp **objects up to 500 g**. Designed with **3D-printed** structures and a **flexible gripper**, the system integrates a **distance sensor** for precise object handling. Control is achieved through a **custom PCB**, running firmware on **FreeRTOS** and fully integrated into the **ROS2 MoveIt 2** framework.

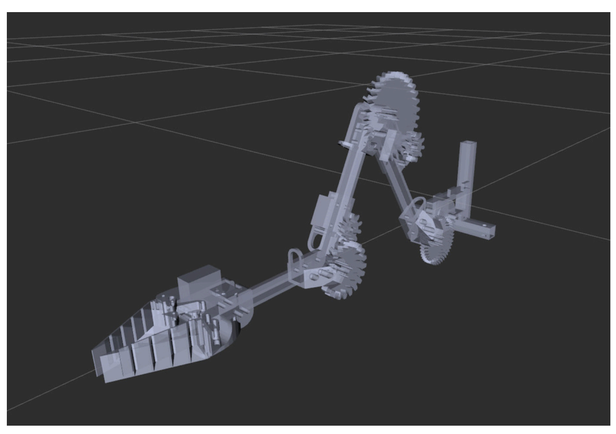

Fig. 2: New manipulator on MoveIt 2.

Software Architecture Overhaul

The robot's legacy **ROS1 state-machine system** was replaced with a **parallel ROS2 architecture**, enabling **multi-tasking**, **flexibility**, **and scalability**. This new structure is organized into **Skills, Managers, Conductors, and Plans**, improving coordination and responsiveness. To ensure portability, the team uses **Dockerized nodes**, allowing easier updates, deployment, and efficient use of resources in competition environments.

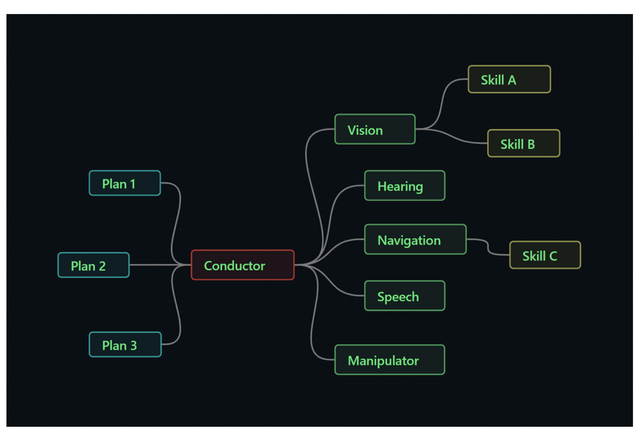

Fig. 3: Overview of the components of the new software architecture.

Software Systems

- **Navigation:** Antares employs **ROS2 Nav2 with SLAM Toolbox**, generating **high-resolution maps** and performing **localization with AMCL**, while the **custom ROSAria2 driver** enables smooth communication with the Pioneer 3-DX platform.
- **Computer Vision:** the robot integrates **YOLOv8** for object detection and **CNN-based** face recognition, combined with **Kinect V2 depth sensing** to enable object interaction and autonomous human tracking.
- **Human-Robot Interaction:** Antares uses open-source large language models (**RoBERTa and LLaMA3.1-8B**) for dialogue understanding, supported by **Whisper** for speech recognition and **Nix-TTS** for speech synthesis, ensuring **natural and reliable communication** in domestic and competition scenarios.

Conclusion & Future Work

Antares underwent a **complete hardware and software renewal**, enhancing its domestic service capabilities in interaction, manipulation, and navigation. Future work focuses on expanding **human-robot interaction with LLMs**, improving **object manipulation performance**, and scaling the platform towards international RoboCup competitions, aiming to create an assistive robot capable of supporting disabled people in daily activities.