PEQUI MECÂNICO

Núcleo de Robótica

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MISS PIGGY

RoboCup@Home 2023

Introduction

Pequi Mecânico Robotic team exists since 2011 and took part in Latin American and Brazilian Robotics Competition in at least one category: IEEE Standard Educational Kit (SEK), IEEE Open, RoboCup Small Size Soccer (F180), IEEE Humanoid Robot Racing (HRR), IEEE Very Small Size Soccer (VSSS), RoboCup Soccer Simulation 2D. This banner describes the service robot Miss Piggy. This competition has influenced the development of research in natural language processing, computer vision, autonomous navigation.

Computer Vision

The computer vision was possible due to the use of Jetson Inference and YoloV8, besides, it also allowed the current model to be retrained with a personalized dataset and, thus, to recognize new objects without the need to build a model from scratch to perform tasks.

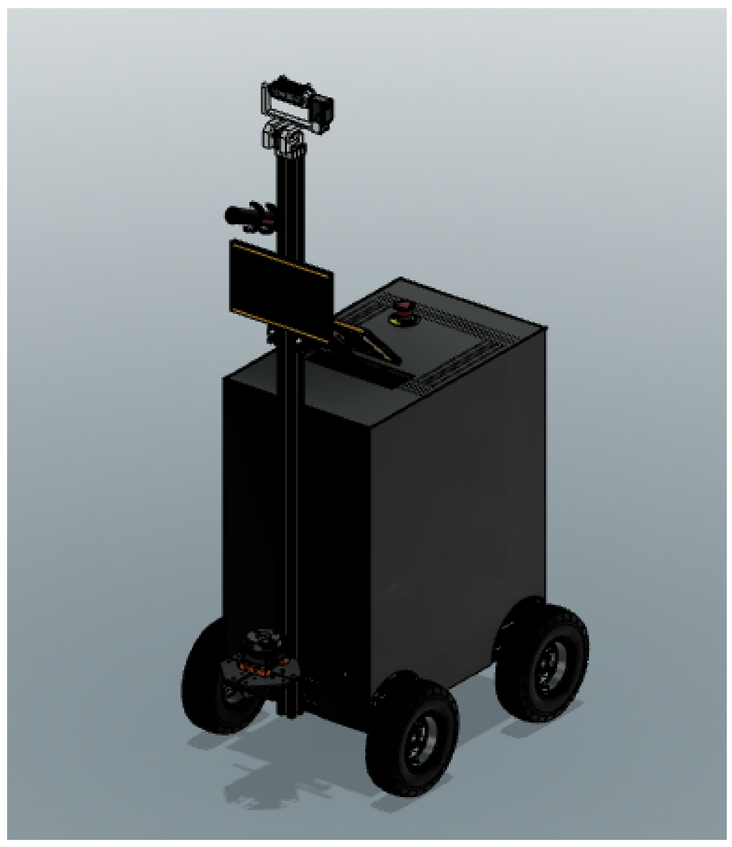
Human Robot Interaction

The robot comprehends the command received by the speech recognition or by the Graphical User Interface (GUI), to achieved that we choose a deep learning approach using a source natural language framework called NVIDIA Riva for Speech related skills and for NLU we deployed a Llama2 Based LLM. This network as trained on a text command generator build by the team that is based on the tasks that the robot is able to perform.

Navigation

To navigate in the robocup@home environment, Miss Piggy employs the Marathon Navigation 2. The robot can move to a designated point while avoiding obstacles using three layers of costmap2d ros2 package's:

1. Obstacle layer: incorporates data from LIDAR and point cloud from realsense sensors.
2. Static layer: uses a map from the mapping phase.
3. Inflation layer: spreads cost values from occupied cells, which diminish with distance per environmental conditions. For optimal movement based on Miss Piggy's physical limitations, a smac local planner is used. An implementation is available in the Robot Operation System, which aids in enhancing the global planner's efficiency and reduces trajectory execution time.



Robot Software Information

Operating System	**Ubuntu 20.04 JetPack 5.0.2**
Middleware	**ROS 2 Foxy**
Navigation	**ROS2 Navigation Stack**
Localization	**AMCL**
Mapping	**Gmapping**
Object Recognition	**YoloV8**
Human Detection	**OpenPose**
Speech Synthesis	**FastSpeech & HiFi-GAN**
Speech Recognition	**Conformer-CTC**
Natural Language Understanding	**Llama2 Based Model**

Robot Hardware Information

Base Motors	**4x Hoverboard Wheel Motor 6,5"**
Microphone	**Rode Videomic GO**
RGB-D Camera	**Intel Realsense D435i**
Speaker	**JBL Charge 3**
IMU	**BNO080**
LIDAR	**RPLidar A2**
Primary Embedded System	**NVIDIA Jetson Xavier AGX**
Secondary Embedded System	**Intel NUC i7**
Gimbal Setup	**2x Dynamixel Servos MX28AT**