Power Supply and Software for Life-sized Humanoid Robot

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ABSTRACT

Driven by the end goal of developing enhanced humanoids for both pediatric care as well as humanitarian aid purposes, this project is undertaking the problem of developing game-changer humanoid robot control and human-robot interaction mechanisms.

In robot assisted Urban Search and Rescue (USAR) missions as well as many other applications such as mining, Autonomous Robotic Systems (AuRoS) are required to navigate and search disaster environments for victims, identifying areas of concern, perform repair activities, etc.

In this project, an architecture for a system that enables AuRoS and humanoids to navigate in a dynamic, rough terrain environment by adapting its locomotion as needed, is being developed.

The overall architecture will allow real-time processing of raw sensor data using deep reinforcement learning to control the robot via a robot operating system (ROS) interface to improve its stability and agility for rough-terrain navigation.

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INTRODUCTION

Since 2014, the Robotarium robotics lab directed by Dr. Alex Ramirez-Serrano has been developing a life-sized humanoid robot (fig 1). The hardware is almost complete; however, to make the robot fully operational there is a need to enhance the previously developed software.

Team JAVAD, a team comprised of two software and three electrical students, took on the challenge of enhancing the robots all around software as well as the need for an integrated power supply.

METHODS AND MATERIALS

- In regards to the software aspects of the project:
  - Our software development life cycle consisted of establishing sprints, then executing on set deadlines. This required that we were present in the robotics laboratory on an almost daily basis.
  - Our work required that we become familiar with several hardware components including:
    - Velodyne LiDAR Sensor
    - Intel RealSense T265 Camera
    - Vectornav IMU
    - BOTA Force Torque Sensors
    - Dynamixel Motors
  - Our methods leveraged several programming languages, frameworks and notable libraries including:
    - ROS1 (Robot Operating System)
    - Python 3
    - C++
    - XML
    - RVIZ
    - URDF (Unified Robot Description Format)
    - Kivy Framework
    - Ubuntu
    - MobaXterm

- In terms of the hardware components of the project:
  - We began by becoming familiar with the robot's and switch's connections.
  - This was done to create a schematic that functioned well and was simple to understand.
  - We produced numerous designs and ultimately were able to achieve one which looked professional, easy to comprehend and most importantly would cause the robot no harm when implemented. We are also looking for a battery that can replace the non-removable power source.

RESULTS

ADVANCED GRAPHICAL USER INTERFACE (GUI)

Re-developed GUI to improve upon several criteria including fluidity, functionality, availability, and ease of use. The new GUI requires a single interface to be open with significant improvements in functionality and response time.

HARDWARE RESULTS

Made schematics and successfully implemented the switch in the robot.

Research on various batteries to facilitate the selection of a better battery.

Found a battery for the robot that can replace the power supply.

ENHANCED ROBOT OPERATING SYSTEM

Configured and enhanced the previous ROS packages to interface with sensors and display their data in the GUI

INCORPORATION OF URDF VIEW AND CONTROL

Added a dynamic display of the URDF through RVIZ which broadcasts a camera stream of the model to the localhost.

DUAL NUC-11 PC PRO INTEGRATION

Designed new ROS architecture requiring us to split current ROS architecture into two PC-level Intel NUC 11 Pro computers.

NEW IN-DEPTH SETUP & INTERFACE DOCUMENTATION

Updated and added critical in-dept detail to previous version of setup/configuration documentation resulting in '*Advanced Humanoid Robot User Manual V5*'.

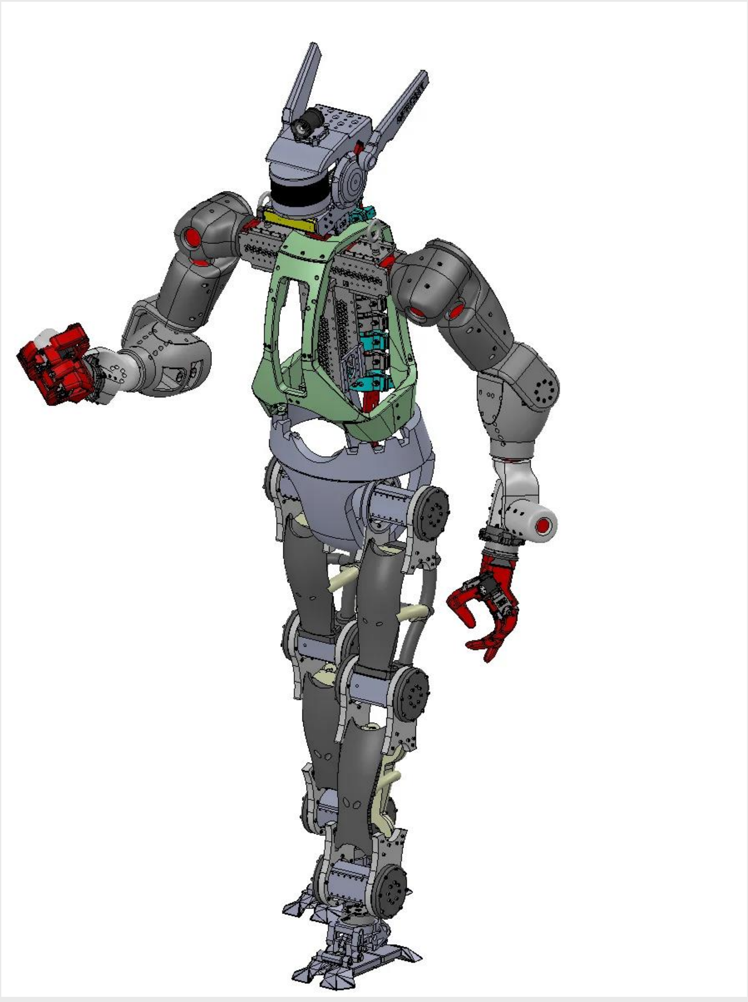

Figure 2. Transcend Prototype.

REFERENCES

[1] "Unmanned Vehicles: Canada," *UVS Robotics Lab*. [Online]. Available: https://www.uvs-robotarium-lab.ca/. [Accessed: 20-Mar-2023].

HUMANOID ROBOT

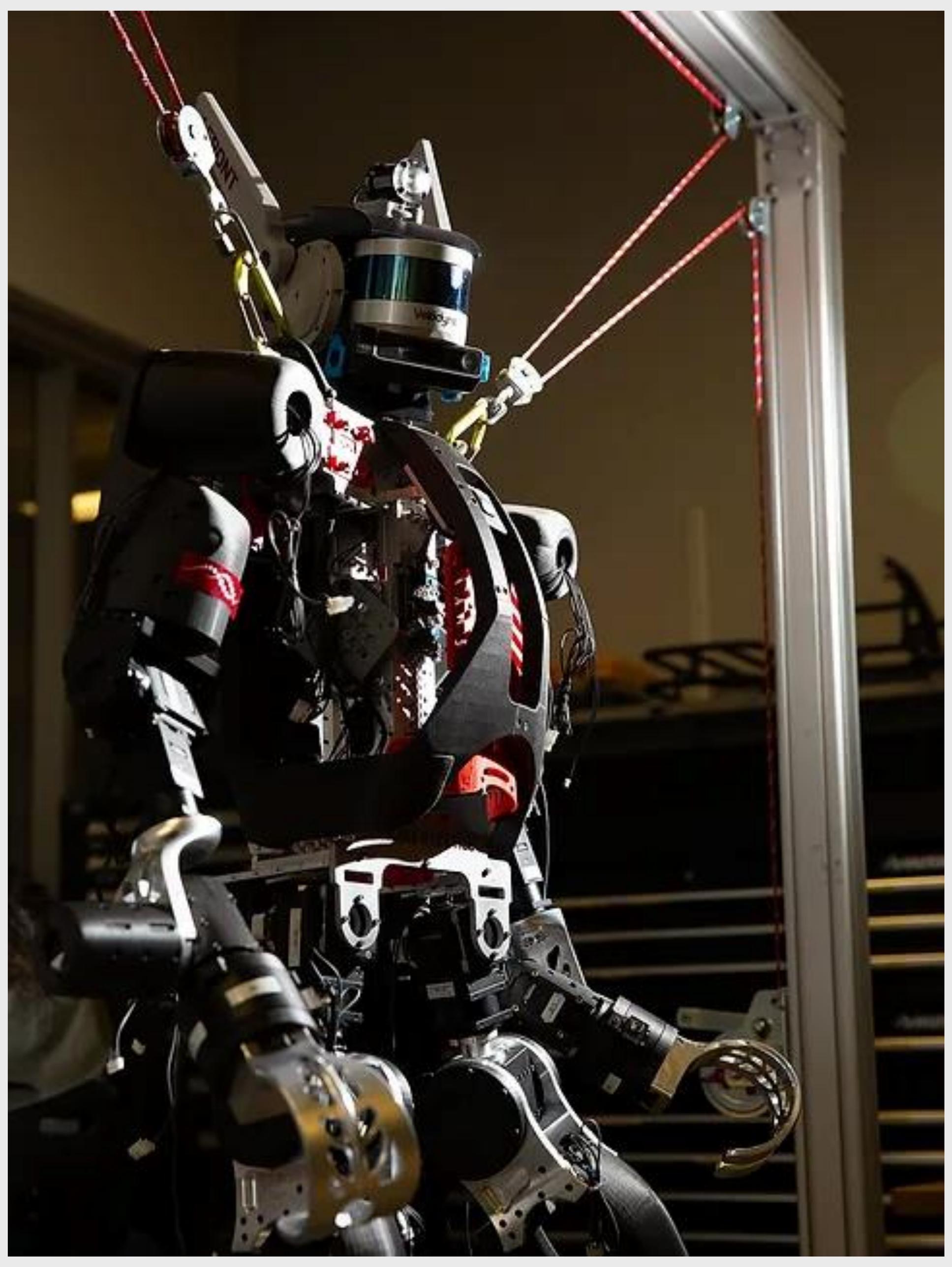

Figure 1. Humanoid Robot.

CONCLUSIONS

- All inclusive, our project goals were ambitious, yet we capitalized on most. Of the proposed deliverables we followed through with:
  - Integrate URDF into GUI
  - Design a new advanced GUI with fluid components.
  - Enhance current state of ROS software.
  - Dual PC integration
- We would like to address several challenges we faced, including:
  - Lack of existing setup and configuration documentation.
  - None or ancient documentation for many ROS1 issues. Note: ROS1 no longer supported as of May 2025.
  - Difficulties accessing the lab in the first semester.

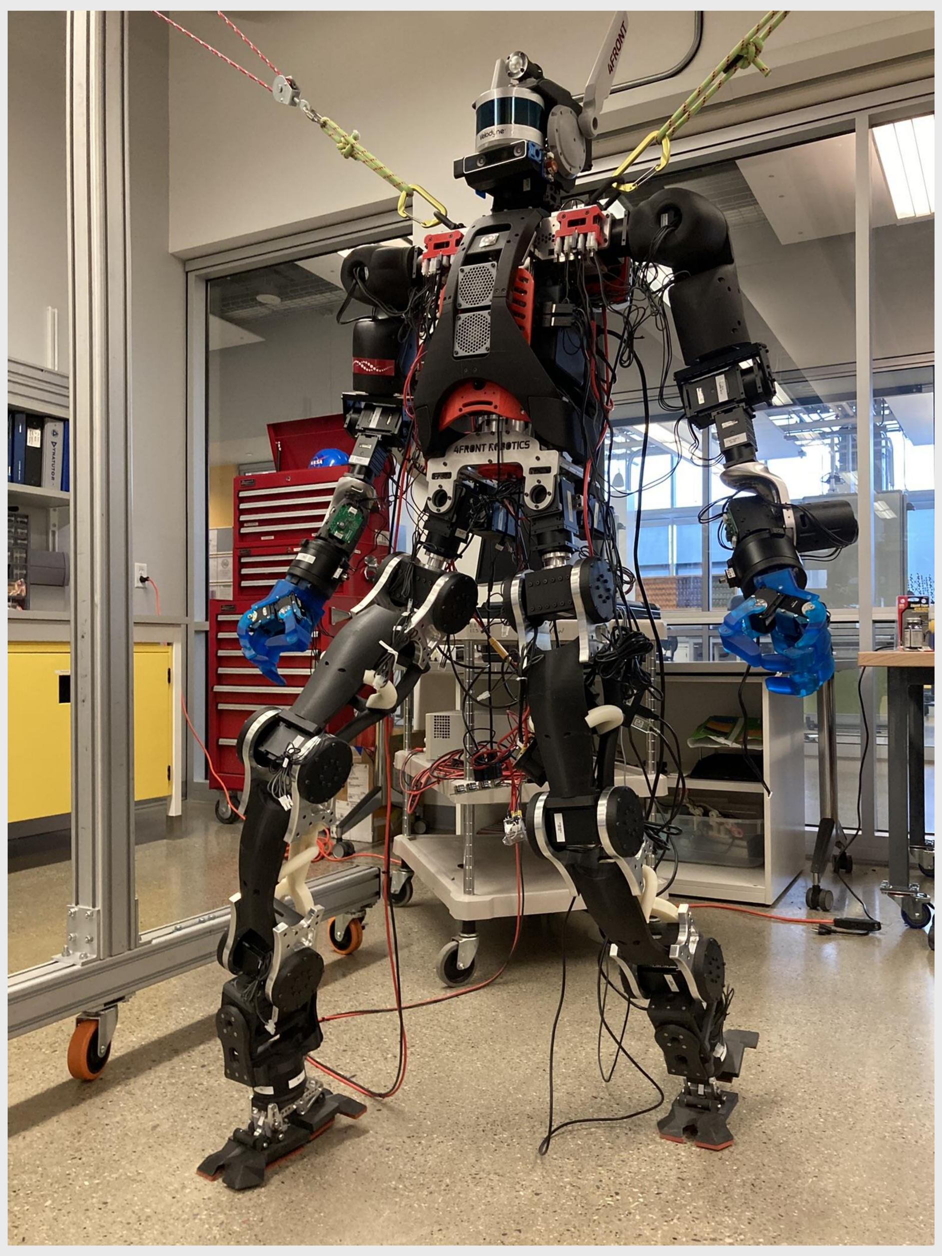

Figure 3. Humanoid Robot Ground POV.