Humanoid Robot Software Interface

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Abstract

This Project makes use of various complex concepts, including but not limited to:

- **LiDAR**: A device that uses laser scanning to create a high-quality 3D map of the space surrounding the sensor based on how the lasers are reflected back.
- **Contact Wrench Set (CWS) Stability**: A stability algorithm that uses force at various contact points to calculate the robot's stability and keep it from falling over.
- **Static Stability**: A stability algorithm that uses centre of gravity to keep the robot from falling over.
- **GUI**: The Graphical User Interface that lets humans see the data the sensors put out in a way that it can be easily interpreted.

Introduction

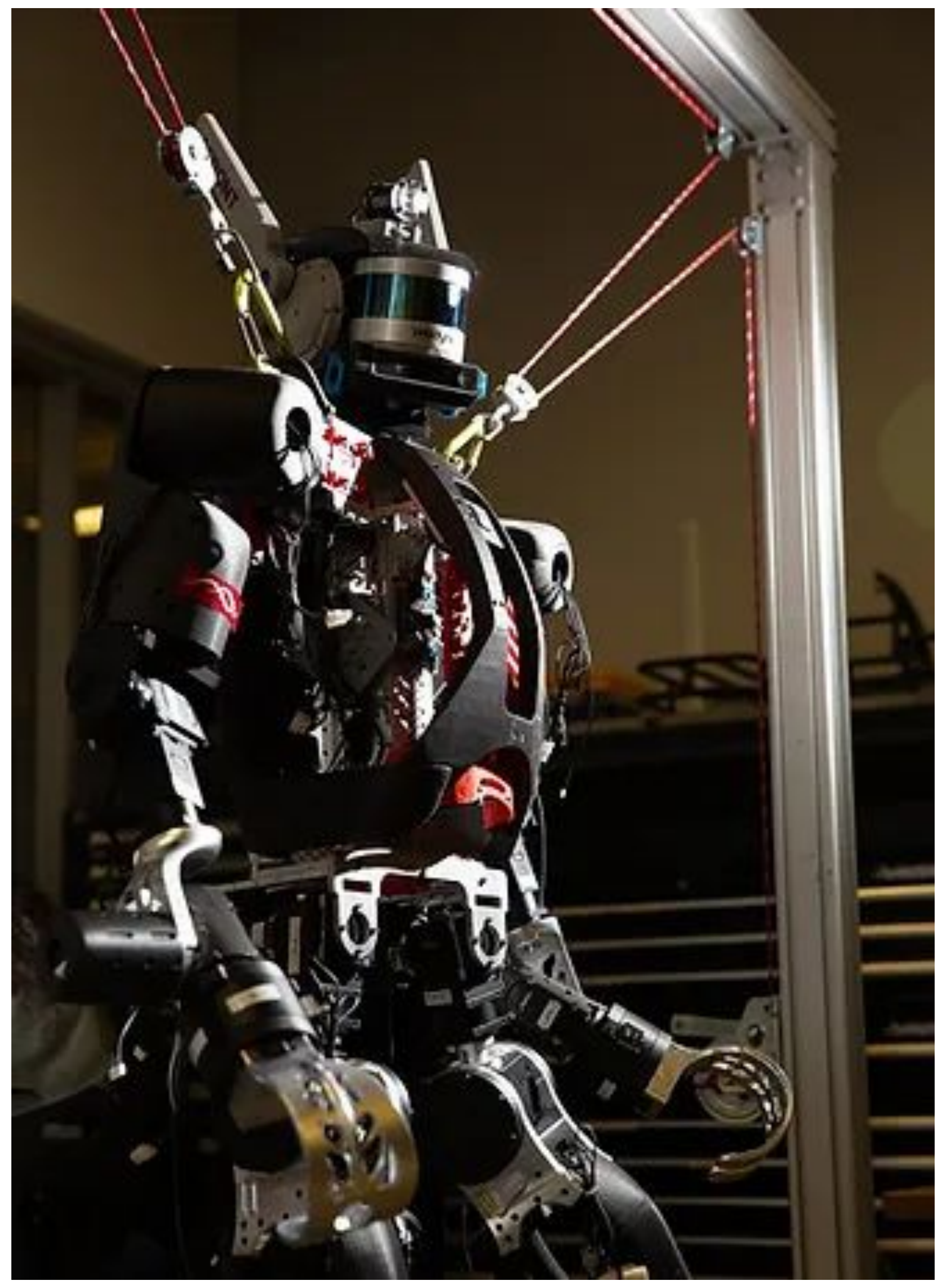
- With many of today's rescue operations being too risky for humans to carry out, the introduction of robotic systems to this field has become quite a hot topic.
- These robots must be very complex in nature to carry out the tasks needed for rescue, and therefore are often very complicated to operate.
- Because of this, the addition of middle layers between human and machine operation are required to allow anyone, regardless of their knowledge of robotics to operate this machine and understand the data that it gathers.
- Making this possible requires a simplified graphical user interface that properly displays the data

Discussion

- Through the use of ROS (robot operating system) we were able to construct modules for each type of data outputted by the sensors.
- This could then be interpreted with a middle script and then sent to the graphical user interface, which can display it in a way where it's easy for humans to interpret and respond to.

Conclusions

- By establishing a proper GUI system for the robot's complex sensor systems, we were able to effectively increase the user friendliness of the robot and allowed its data to be interpreted by humans.
- By accomplishing this, the robot becomes much more robust and easier to operate, making it much more field-ready and able to perform its job when operated in rescue operations.



Results

- The Lidar is able to scan the room at a rate rapid enough to capture and display movement.
- This allows the robot to view in real-time its surroundings and obstacles that may present a challenge to its movement.
- The GUI is able to display this real-time data in such a manner that humans are able to interpret it and take corrective actions when operating the robot.
- The two stability methods are able to be used at different periods and for different tasks

Methods and Materials

- The different modules of this project made use of different sensors and programming environments, including, but not limited to:
  - **LIDAR Sensor**: The sensor used to build a 3D map around the robot using lasers and the time taken for them to reflect back. This works fast enough and with enough accuracy to detect moving objects and obstacles that the robot may need to change its movement patterns to overcome.
  - **Force-Torque Sensor**: A sensor used on the robot's arms and legs to measure applied force in all directions. This can be used to determine movement, balance and stability of the robot, which aids to keep it from falling.
  - **Robot Operating System (ROS)**: The framework used to develop the code modules in such a way that allows for processes to gather data to and from other processes.
  - **KivyMD**: The python-based user interface framework that allows widgets and such to be added to a view to interact with the system while viewing the data.

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