

Introduction

Description: The goal of this project is to build a self-balancing unicycle based on a real-time system controller. Specifically, since the project is for National Instruments (NI), the design will involve NI hardware products programmed using NI's LabVIEW software. The robot should be autonomous in the sense that it is self-balancing without external human interference. The main purpose of this project is to create a control algorithm that will continuously receive feedback from the environment or sensors and correct the system's falling behavior. The sensors will provide the feedback to the closed-loop system.

Additional goals not required by the client include intentional movement or travel, turning under remote operator/pilot, further self autonomous navigation, and obstacle avoidance.

Importance of Project: This project is meant to be a showcase of National Instruments technologies solving a difficult controls problem in robotics. If the project is successful, then there is a possibility that the project could be premiered during the next NI Week in Austin, TX later this summer. Specifically this real-time implementation would demonstrate the high speed processing capabilities required to perform the corrections of an inherently unstable balancing system.

Previous Solutions: While previous balancing projects have been done similar to this project, few have been made solely with NI hardware, and none have also been made with a true unicycle. An example of a self-balancing ball bot from a team in Australia was provided as an example as both; a similar inverted-pendulum controls problem, and a real-time robotics system. Many mobile robotics systems involving inverted-pendulum, inherit unstable and non-linear characteristics have been implemented, but what is truly unique about this project is the method of locomotion or contact with the ground. Dynamically-stable mobile robots designs such as dicycles, bicycles and omnidirectional ball-bots have been both well documented and implemented; see the Segway personal transport or CMU's ballbot for modern examples.

Although marketed motorised balancing unicycles exist, true two-axis self-balancing ride-able unicycles such as the Honda U3-X are not quite unicycle since the device is powered with omni-wheels. Even a more traditional single-axis self-balancing ride-able unicycles, like the Uno or SBU V3, rely on a human rider to correct for the side to side balancing requirements. Though the challenge of a single-axis self-balancing robotics unicycle has been documented and studied, this system has been far less implemented in practice.

How the Client would like the problem Solved: The client expects the team to come up with an original, creative, and intuitive design approach. The client expects the team to use an actual unicycle instead of a ball-bot unicycle with mecanum wheels. Furthermore, the client expects the team to use National Instruments hardware and software products such as the compaqRIO and Real-Time LabVIEW control algorithms. The client welcomed the use of off-the-shelf components that would be necessary to solve the design problem. Additionally, the client expects to see a clear,

well-documented design approach and process as the team makes improvements on the project.

Deliverables

- (Fall) Budget of a proposed design and price list
- (Spring) Report documenting the control modeling
- (Spring) Final, self-balancing unicycle

Milestones

End of Fall Quarter:

- Final unicycle design
- Basic control model of unicycle

End of Winter Quarter:

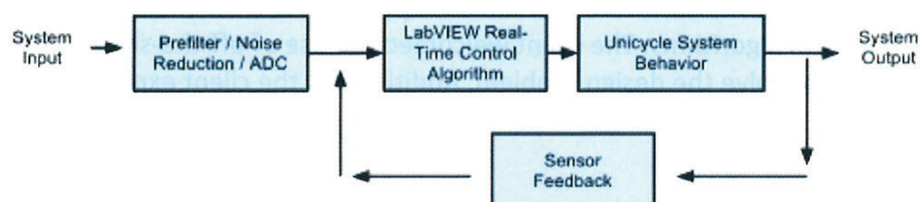
- Finished unicycle prototype with all sensor interfaces running.
- Basic control algorithm.

End of Spring Quarter

- Final product with all sensor interfaces
- Detailed control algorithm.
- Final documentation.

Block Diagram description of the Project

Closed-Loop System Design

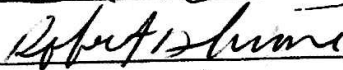


Signatures

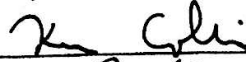
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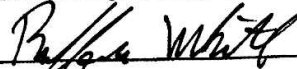
Supervisor:



Team Leader:



Team Member 2:



Team Member 3:



Team Member 4:

