NEURAL ROBOTICS: DEVELOPMENT AND CONTROL OF AN ARBOTIX-M BASED SPIDER ROBOT

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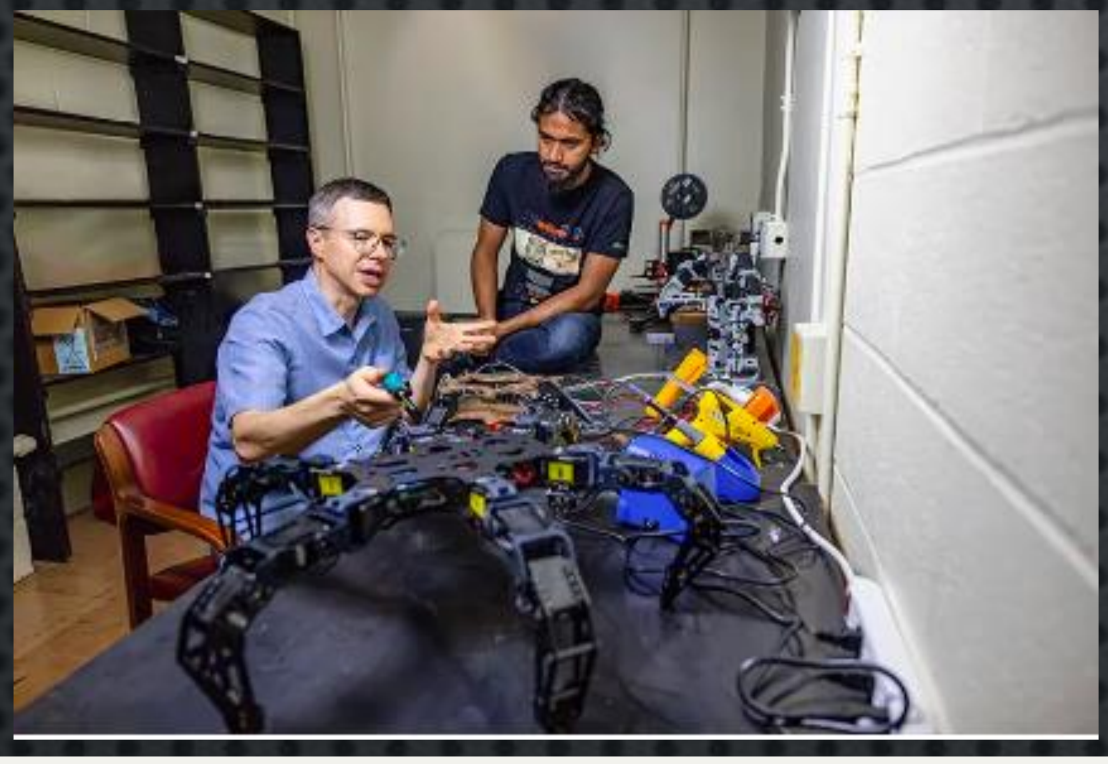
Introduction

Neural robotics integrates neural networks with robotic systems to achieve adaptive and autonomous behavior. In this research, we developed a spider robot using the Arbotix-M board, employing neural control methods to manage locomotion and sensory feedback. The robot's design incorporated microcontroller programming (C, C++), ROS integration, and MuJoCo simulation for movement validation. The project demonstrates the application of neural networks in robotics, providing a foundation for future exploration of adaptive control in multi-legged robots.



Methods

Hardware Implementation:

• The spider robot was constructed using an Arbotix-M board as the central controller, interfaced with multiple servos for leg movement. The design allowed for precise articulation and control of each leg joint.
• Sensors were integrated for feedback, enabling real-time adjustments in the robot's movement based on environmental inputs.

Software and Programming:

• The robot was programmed using C and C++ for microcontroller-level control, ensuring efficient execution of locomotion algorithms.
• ROS (Robot Operating System) integration is currently in progress, with plans to utilize it for managing communication between the sensors and the Arbotix-M board to facilitate seamless data exchange and control commands.

Consideration:
The Arbotix-M board's processing limits required optimizing neural control algorithms, and sensor calibration was essential for accurate feedback. ROS integration is ongoing to enable efficient sensor-controller communication. Tests were conducted indoors, and adapting to varied terrains is planned. Differences between MuJoCo simulations and real-world movements required adjustments during implementation.

Figure 1

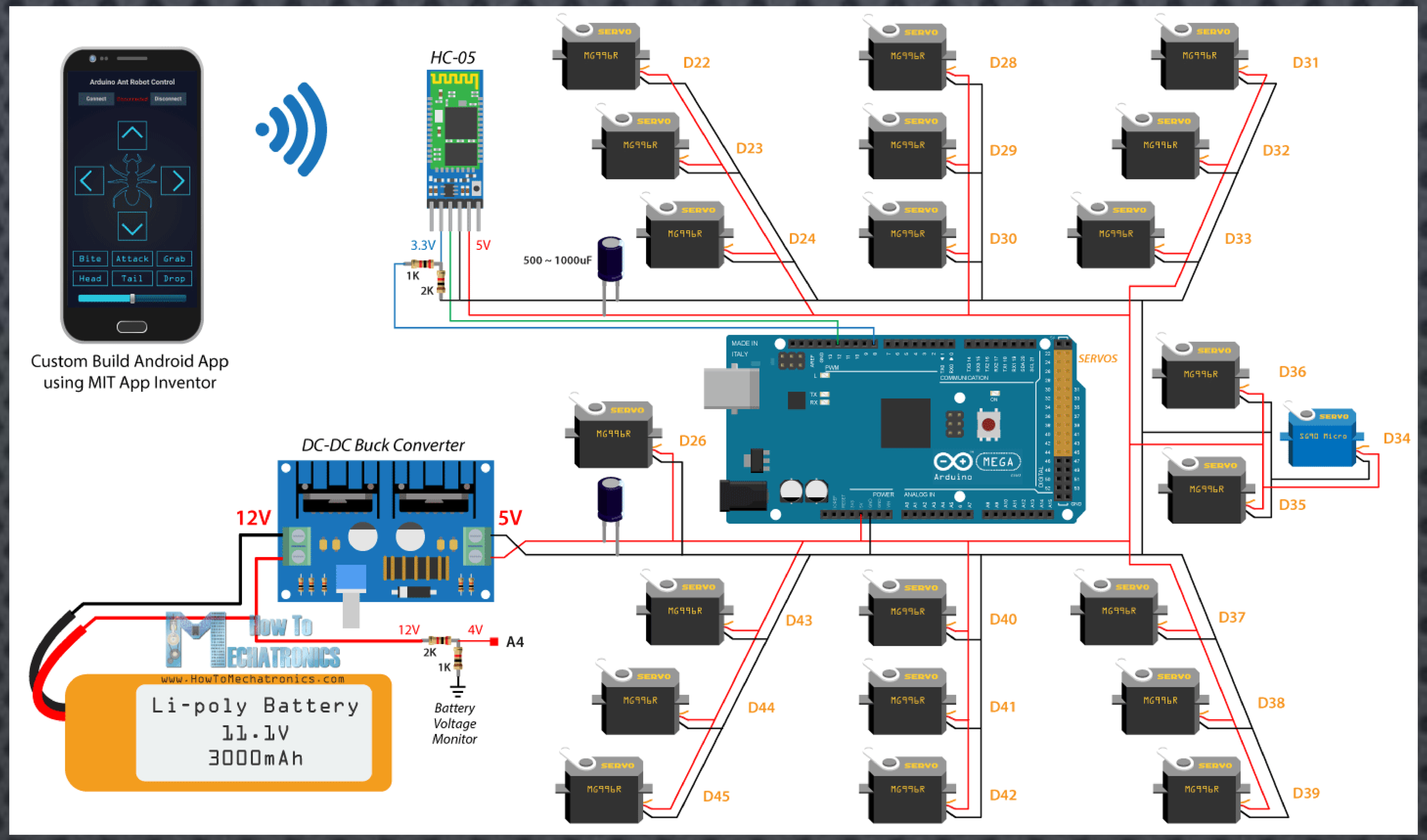


Figure 2

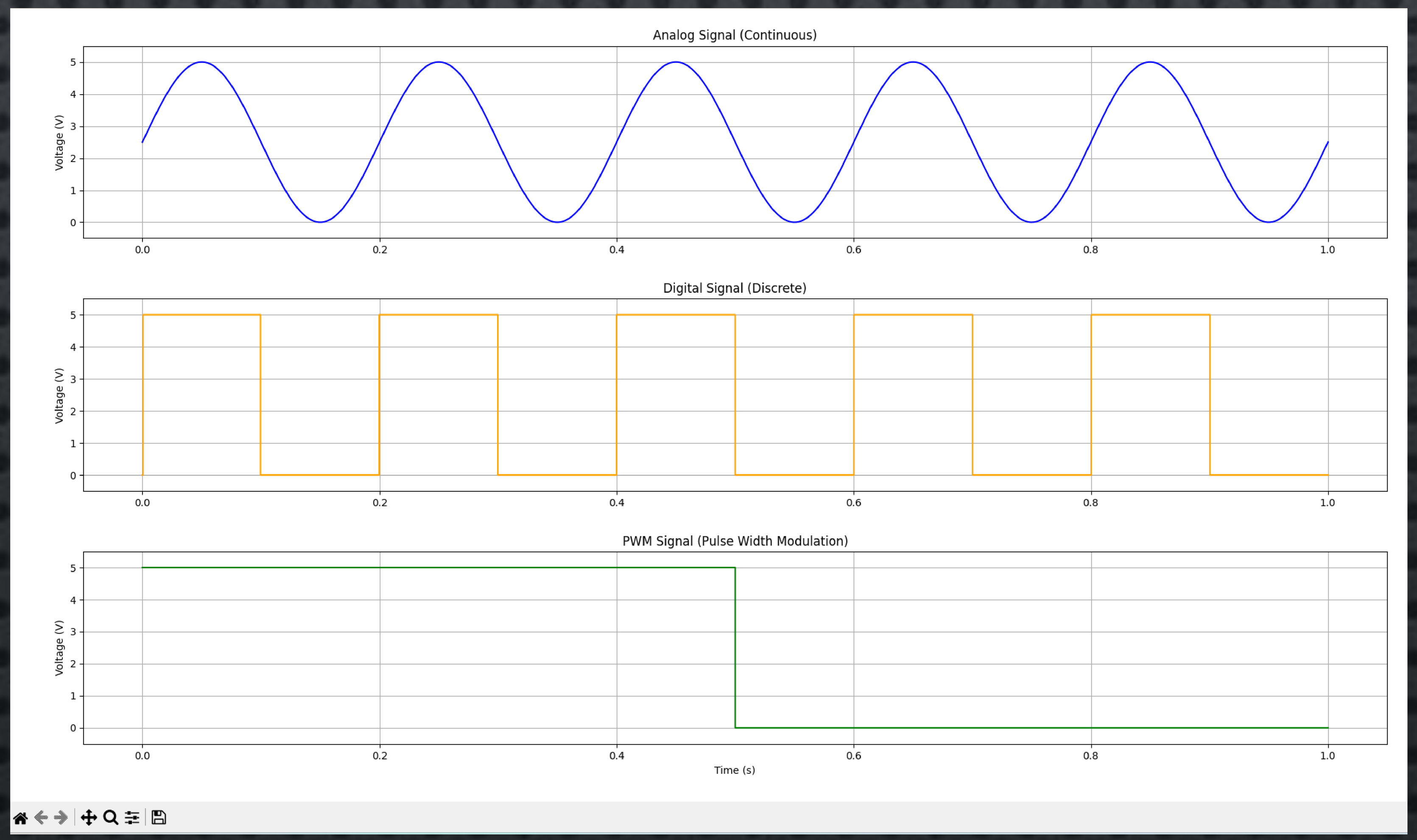
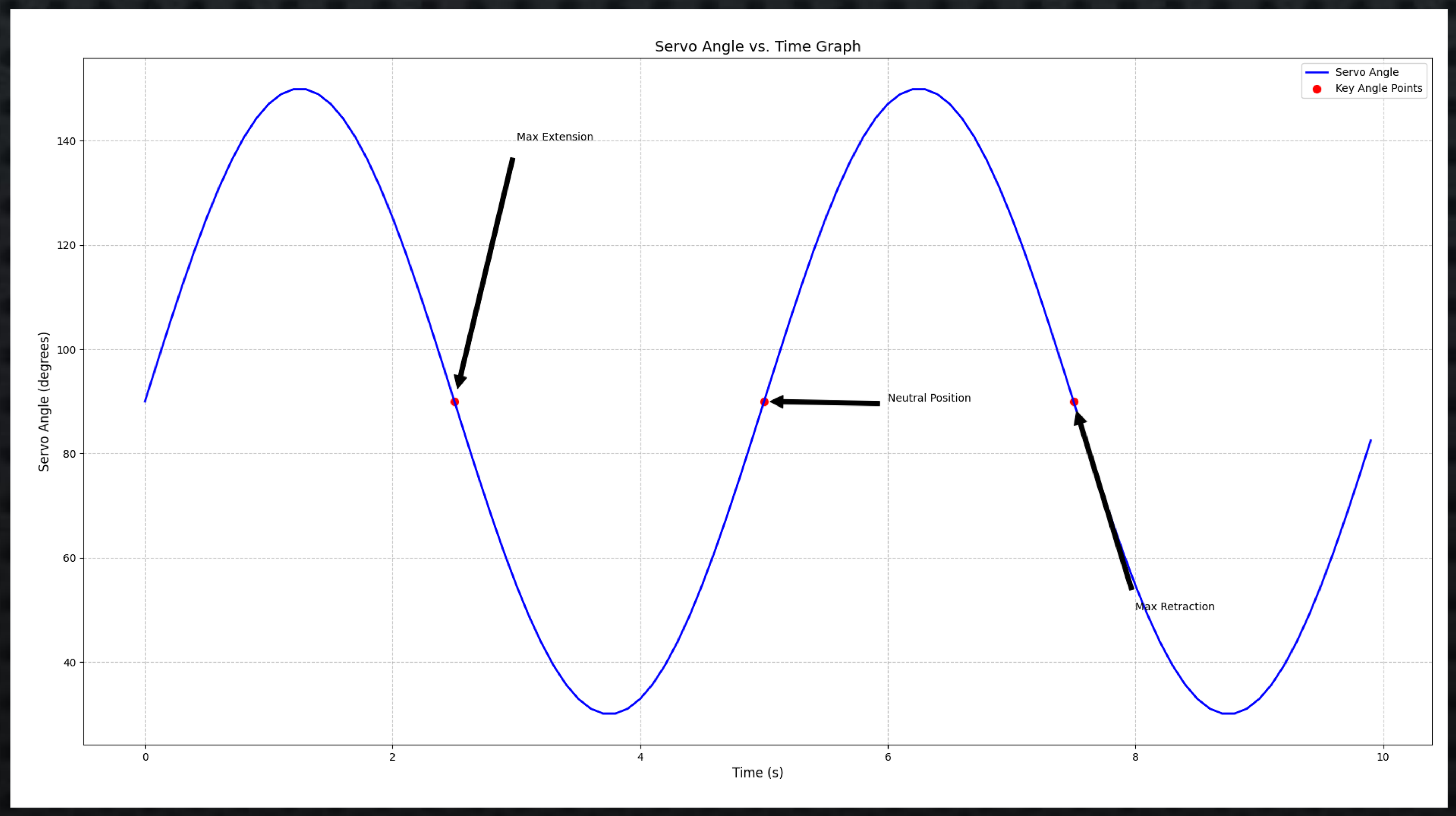


Figure 3



Servo Angle vs. Time Graph

Results

- Successfully developed and controlled the spider robot using the Arbotix-M board.
- Demonstrated smooth, pre-programmed walking patterns with accurate servo movements via PWM signals.
- Preliminary tests confirmed precise motion and responsiveness.
- Ongoing work includes integrating ROS for real-time control.
- Neural network implementation is in progress for adaptive behavior.

Discussion and Future Work

- The spider robot demonstrated effective locomotion with pre-programmed control, validating the Arbotix-M board and servo integration.
- ROS integration is currently in progress and expected to enhance real-time responsiveness and control.
- Future work includes implementing neural network integration for adaptive and autonomous behavior.
- Plans involve testing the robot in diverse environments to assess performance on complex terrains.
- Exploring advanced sensor integration to further improve the robot's autonomy.

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