Control system to balance a robot on a moving sphere

Loughborough University

Background

- The robot below was provided by a previous student project
- Includes three omni wheels and three large stepper motors, each with accompanying drivers
- It suffered from some hardware limitations were resolved throughout the project
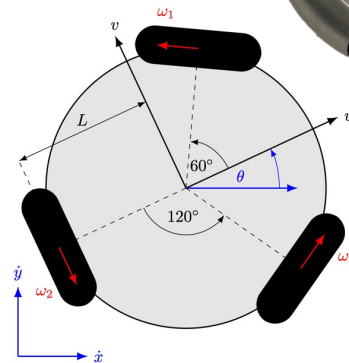
Variable PWM control used to operate motors at responsive varying speeds
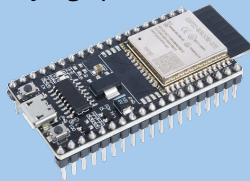
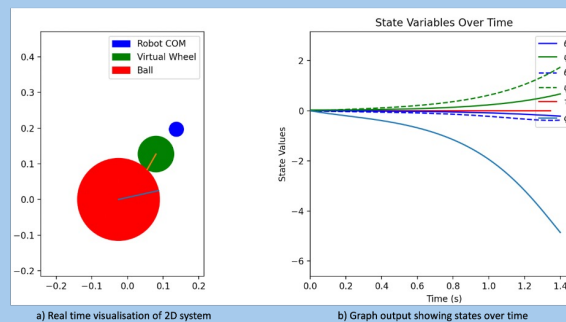Microcontroller was upgraded to an ESP32 for faster speeds and more memory
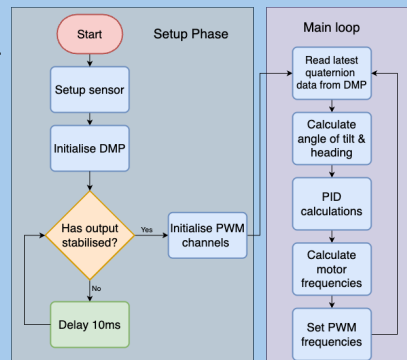
Omni-directional wheels -->

Inverse kinematics were computed to drive wheels at correct speeds

Simulation

A 2D simulation was developed to assess different control techniques and learn about the dynamics

a) Real time visualisation of 2D system

b) Graph output showing states over time

Orientation Sensing

- IMU (Inertial Measurement Unit) needed extra firmware only available with microcontrollers with greater memory capacity.
- Outputs quaternions to be turned into orientation vector.
- Accuracy of measurements remained within ±2.5° of actual angles.

Orientation error across 330 samples
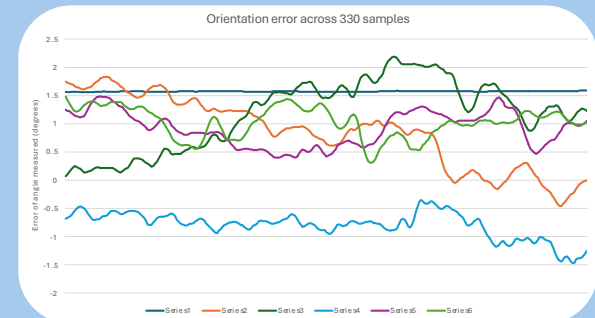
Basic controller was implemented and it balanced !

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