

# Omnisphere

Chris Ballentine, Gerardo Dudamel, James Frisbie, Macdonald Taylor

Faculty Advisor: Dr. Gibbs, Department of Electrical and Computer Engineering, Florida Institute of Technology

## Introduction

Our Omnisphere robot is a user-friendly controlled platform with three spheres for wheels. A friction-based drive system rotates each sphere with 360 degrees of full planar freedom. This system eliminates the restrictive motions associated with common cylindrical-wheel systems and utilizes previously unattainable motions.

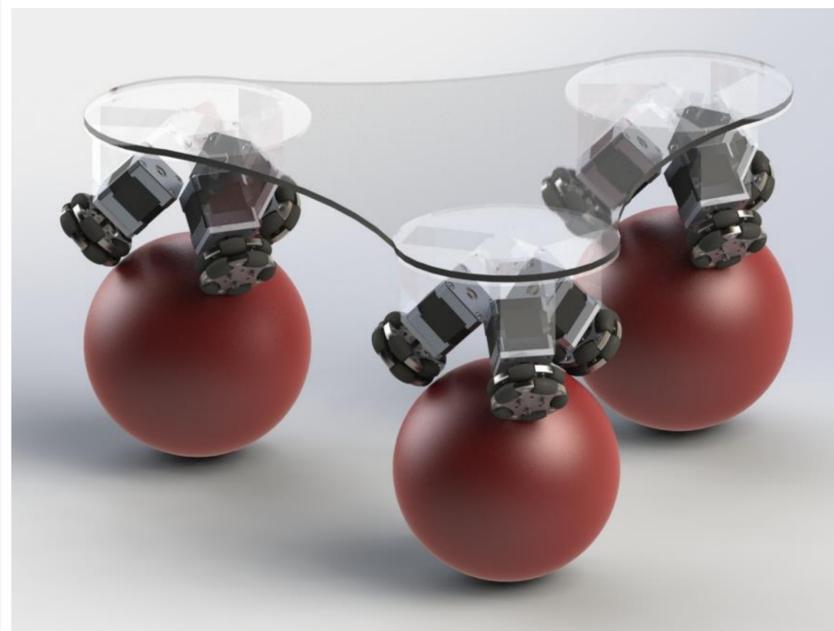
## Description

- The control mechanism for the robot is a PS4 controller wirelessly linked over Bluetooth. The controls are setup to be easily perceived and or adopted by the operator.
- Each frictional drive system consists of three omnidirectional wheels (omniwheels) mounted to the shafts of three stepper motors.
- Omniwheels transfer motion to the sphere when driven CW or CCW. When an omniwheel is stationary, with the robot still in motion, small disks built-in along the circumference of the omniwheel allow for sliding lateral motions to exist between the omniwheel and the sphere.
- The robot is placed atop of the spheres and the weight of the robot forces contact between the omniwheels and the spheres. The spheres then contact the ground.

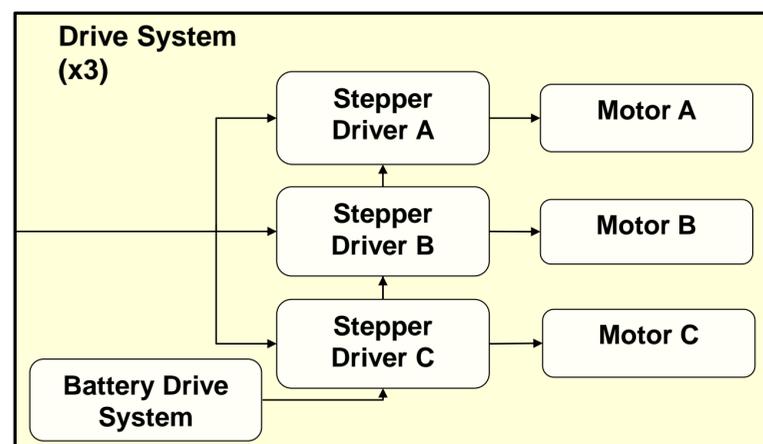
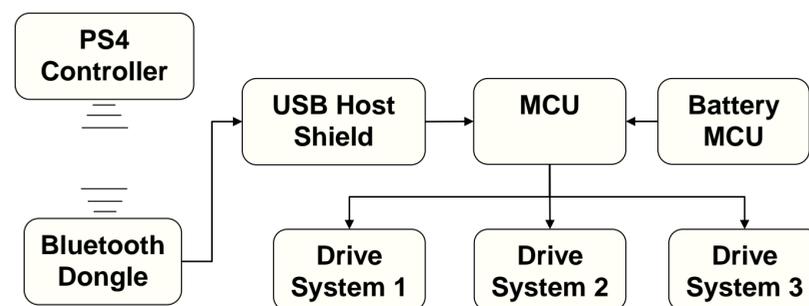


## Advantages

- Able to maneuver around objects with minimal loss of velocity.
- Rotation, swivel, shift, and glide motions can be performed.
- Triangular structure is both stable and lighter than other designs.
- There is no need to 3-point turn or follow arced paths to implement a turn.



## Hardware Diagram



## Design

- The microcontroller (MCU) controls the nine stepper motor drivers by performing algorithms based on the commands from the user. Also, the robot requires at least 45 pins, therefore the Arduino Mega was chosen as the MCU.
- Four batteries ensure longevity of operation.
- The MCU code, in C, was written then optimized to reduce power usage and promote efficiency by enabling and disabling components and by microstepping the motors at higher velocities.
- To maintain strength and minimize weight, the platform was made out of 3.175 mm acrylic.
- Hybrid Nema-17 High Torque Motors rotate the 60 mm omniwheels to drive the spheres.
- Components of the robot were placed strategically to evenly distribute the weight among each sphere improving its stability when carrying a load.

## Vector Algorithm

Total Linear Displacement:  

$$\vec{F}_T = \vec{F}_A + \vec{F}_B + \vec{F}_C$$

Vector Contribution:

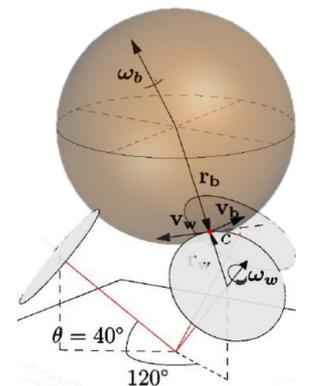
$$F_A = v \cos(150 - \alpha)$$

$$F_B = v \cos(30 - \alpha)$$

$$F_C = v \cos(270 - \alpha)$$

where,

$F \rightarrow$  motor vector contribution  
 $v \rightarrow$  robots velocity  
 $\alpha \rightarrow$  angle of robot movement



## Summary

The Omnisphere robot was designed to be power efficient and straightforward for the user. Its friction-based drive system allows for motions such as rotations, swivels, shifts, and glides. The triangular geometry enhances the platform's strength as well as compactness; therefore moving loads around small spaces is now practical and convenient.

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