



INTERACTIVE SENSOR PACKAGE UNIT

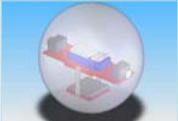
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 Sponsor: Practical Robotic Innovations, LLC, Fort Wayne, IN

Abstract

The Interactive Sensor Package Unit was conceived by the project sponsor to be a device that would intelligently interact with its environment. To that end, it receives sound and motion inputs, and adjusts sound, motion, and light outputs to engage its participant. When an input condition is met, the unit responds based on algorithms programmed into the microcontroller.

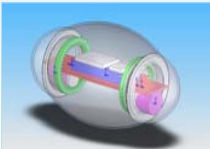
Conceptual Designs

Equilibrium Seeking



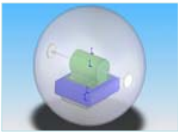
- Dual Motors Driving Shell
- Spherical Shape
- LED's
- Piezo
- Accelerometer

Dual Geared Motors



- Geared Mobility
- Elliptical Shape
- Piezo
- Hall Effect
- Multiple Pieces
- Fiber Optics

Single Motor Shaft Fixed to Shell



- Single Motor
- Lighter Unit
- Speakers
- Mechanical Switches

Rubberized Track



- Textured Tracks
- Tube Shape
- Gear Driven
- Interior Lights
- Mechanical Switches

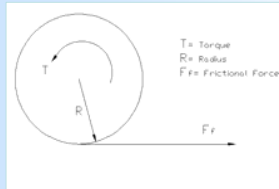
Motorized Rotating Weight



- Erratic Motion
- Single Motor
- Fiber Optics
- Piezo
- Accelerometer

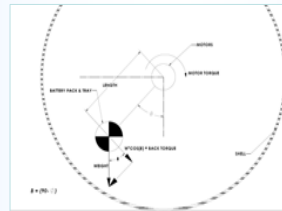
Mechanical Analysis

Mechanical Mobility & Torque



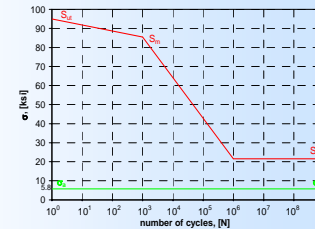
The free body diagram shows the forces considered for the mobility analysis in determining the amount of torque necessary to meet the velocity requirements. With this, motors can be selected that best meet the sponsor's requirements.

Mechanical Back Torque



This analysis was performed to ensure that during operation, the weight of the battery pack and tray would provide a substantial amount of resistance or "back torque" to counter act the torque supplied by the motors and eliminate the possibility of the internal components from spinning inside the unit, resulting in no motion.

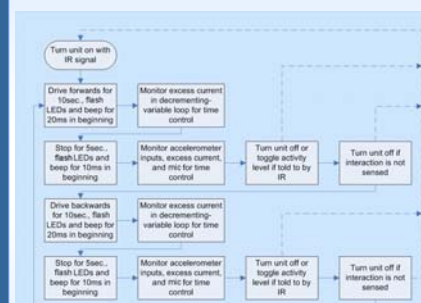
Mechanical Fatigue



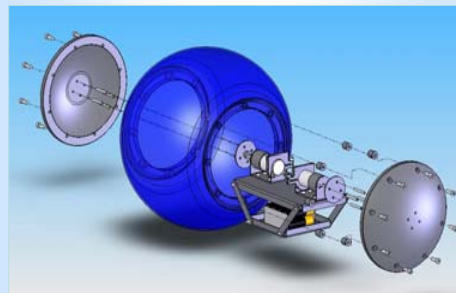
Due to the shafts being exposed to alternating stresses (compressive & tensile), a fatigue analysis was performed to ensure that the motor shafts would not fail during extended use. The green line is the calculated stress of the shafts and the red line is the upper limit where the shafts fail. Since the two don't intersect, the shafts won't fail due to alternating stress.

Electrical Software

Software Algorithm

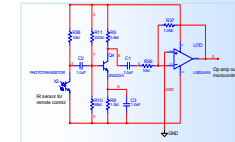


Selected Conceptual Design

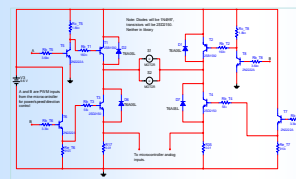


Electrical Hardware

The IR receiver is designed to accept input from the transmitter via the phototransistor. The phototransistor signal is amplified first by a 2N2222A transistor and then by an op amp, resulting in a total gain of ~10,000.



IR Receiver



Motor Drive

The motor drive circuit is a standard H-bridge configuration that has been designed to provide a peak current of 3A to the motors.

Conclusion

The Interactive Sensor Package Unit fits the sponsor's requirements for a device that engages its subject through light, motion and sound.

It also provides a platform for future product expansion.

