CubeSat Control Platform + ACTIV

10/31 Meeting

EMBRY-RIDDLE Aeronautical University

EasyControls.org

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General Updates/Reminders

Student Research Symposium is on **November 15th** in the union

-We'll be presenting during **Session 1 (11:00 to 12:15)**

-The goal is to show up with working demos of the inverted pendulum and ACTIV (1-DoF) as well as the assembled expanded 1U CubeSat

-As it's the 21st century, we should also make use iPads/monitors to display renders or supplement inverted pendulum demonstration (plot PID controller after demo)

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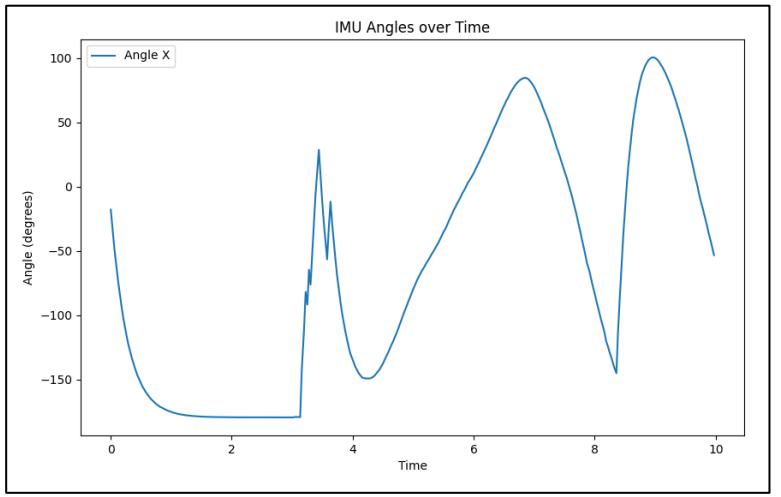
[Justin]: Inverted Pendulum PID + Database Integration



Progress completed this past week

-Added capability to store arm angles in SQ Lite database (>50%)

-Attempted to add pendulum start-up sequence (<50%)

-Assisted in inverted pendulum cable management upgrades

Goals for next week

-Incorporate database functionality into general system architecture

-Add “plot” function to Database class

-Design clamp to fix inverted pendulum in an upright position for program startup

-Reorganize Fusion repo

-Design/Delegate design of ACTIV rotary union w/ motor

-**Make when to meet for VISH/DYL/ISAA**

Anticipated Challenges

-Time crunch with SRS in two weeks

-ODrive, by itself, is not capable of braking the motor instantly (this is required for startup sequence). Instead, we will need an **external braking mechanism** for this.

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[Isaac] +[2DOF/3DOF Cube Sats]

Progress completed this past week

-Printed and Assembled Cube Aat

Goals for next week

Anticipated challenges

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[Ella] + [Inverted pendulum]

Progress completed this past week

-Updated pendulum arm mount to fit cords through after everything is put together

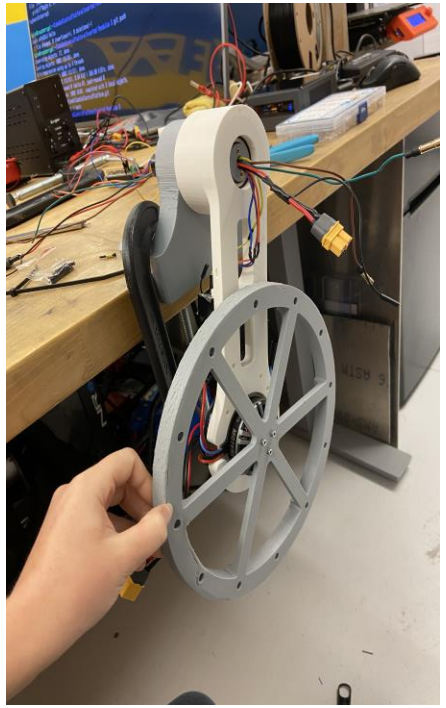
-Assembled second pendulum together

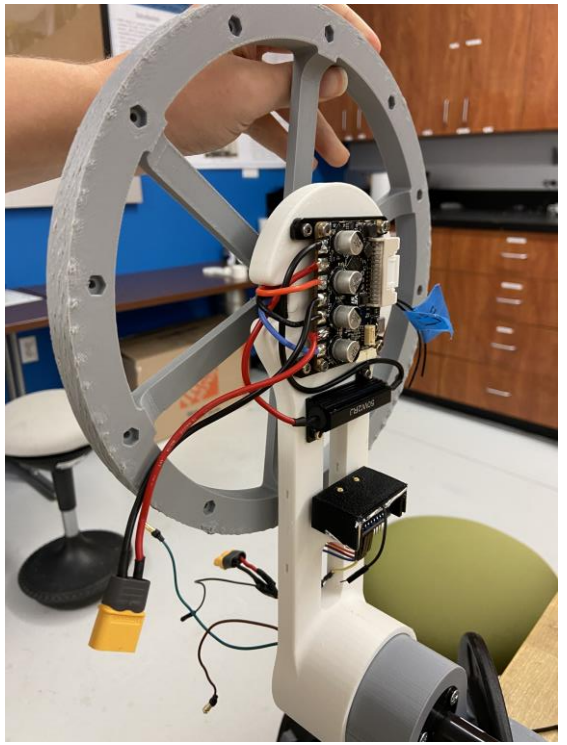
Goals for next week

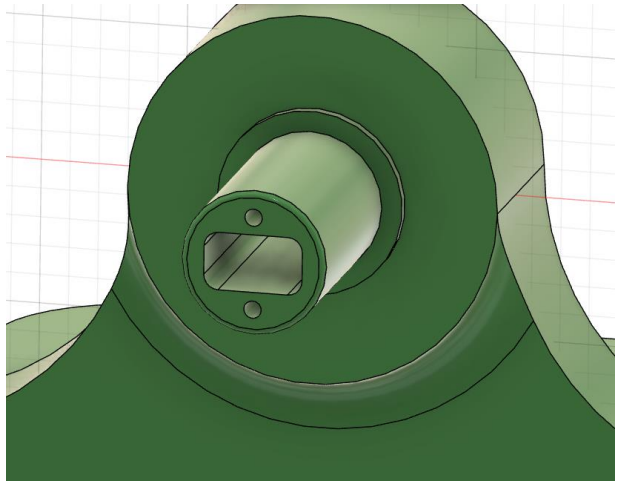
-Make new washer to go in front of the bearings

Anticipated challenges

-Understanding Dylans CAD methods (when even he doesn't remember)







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[Jacob] + [Gyroscope Rings & Camera Stuff]

Progress completed this past week

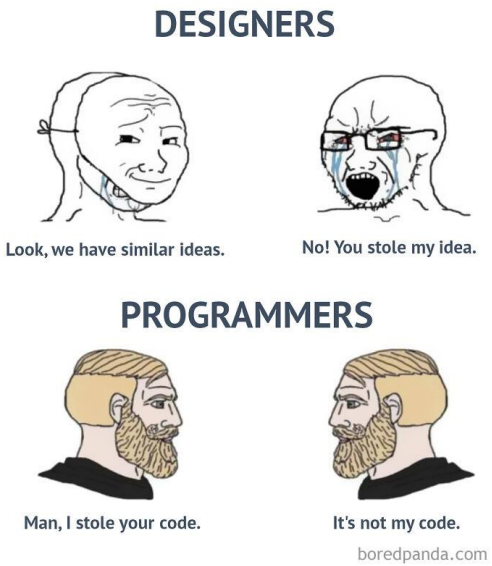
- Discussed image processing with a legit engineer. Found some code that may be a useful beginning for an onboard camera.
- Came up with a weak idea for the gyroscope, need to put more time into that.

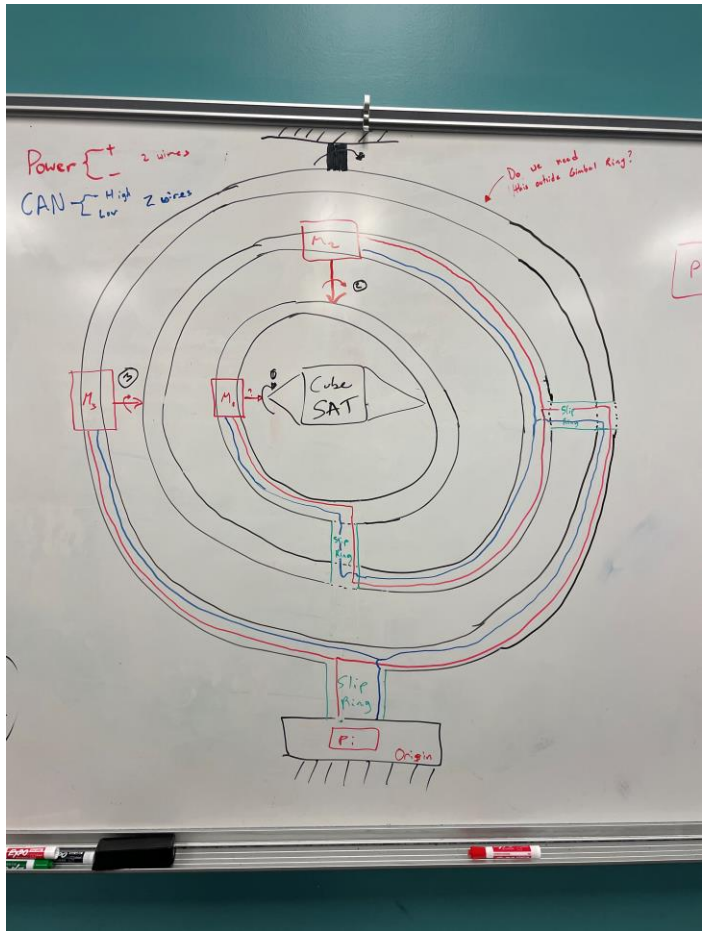
Goals for next week

- Come to a conclusion on the slip ring/gyroscope layout.
- Research more about how real satellite use their cameras for attitude determination.

Anticipated challenges

-Getting familiar with python.





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[Ryan] + [Software]

Progress completed this past week

-Finished Sensor parent class and LSM9DS1 subclass basic functionality

-Finished estimator parent class and added tilt, quest subclasses with basic functionality

-Started data storage class.

Goals for next week

-Add a test.py program to demo functionality prior to pushing to github (tonight after I take a tiny creeper trick or treating)

-Incorporate SQL into data storage class (needs to be done before filtering/filtered estimators)

- Add TODO comments

Anticipated challenges

-Ya boi managed to get a technical interview and has to study

-I don't have a way to test data collection with current program. May need to add serial functionality.

[Spoooooky]

~~COPY~~ O.G.

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[Vishal] + [Inverted Pendulum]

Progress completed this past week

- Raspberry Pi setup
- Python OOP

Goals for next week

- Work with Dylan, rundown of CAN communication

Anticipated challenges

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[Dylan] + [Embrace Fall]

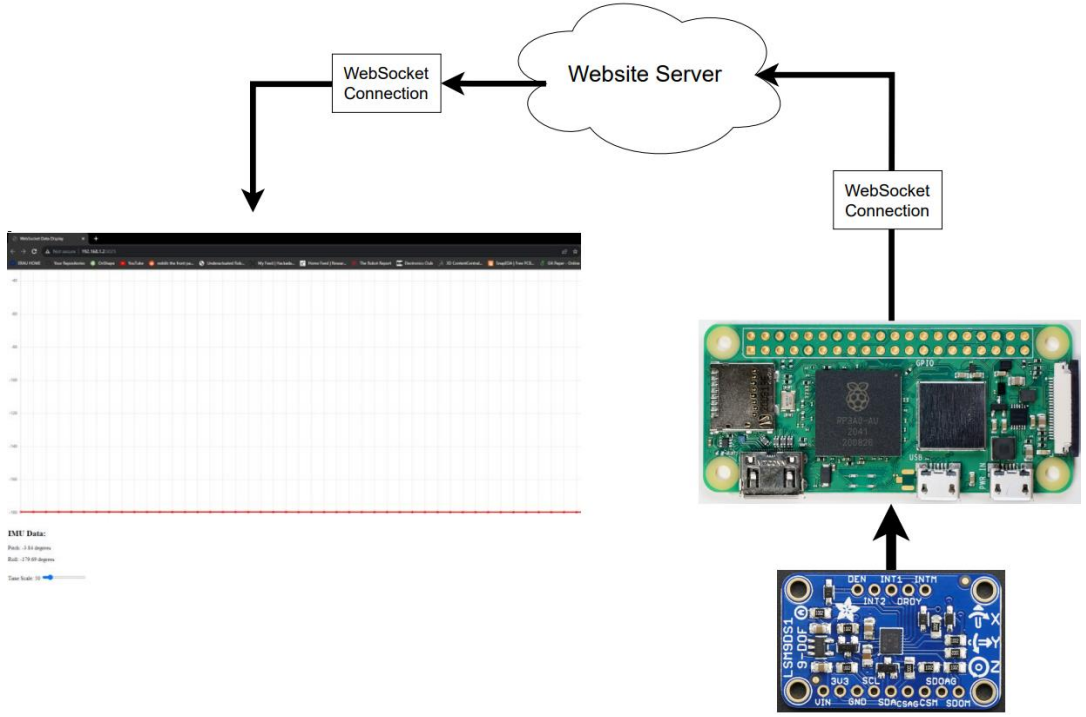
Progress completed this past week

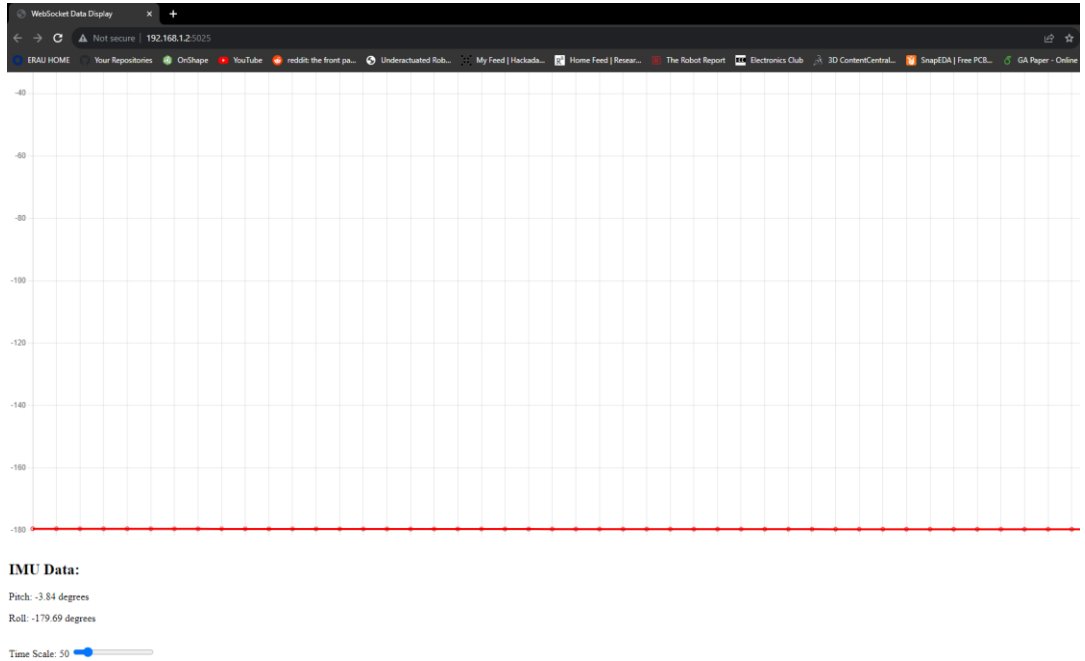
- Work on ACTIV Motor Torque Calcs w/ Justin
- Worked on understanding O-Drive CAN Messages
- Work on Website for live streaming data visualization
  - Maybe get unity sim integrated

Goals for next week

- Get CAN Control
  - Torque Control
  - Controlling multiple motors at once
- Implement simple PID on Inverted Pendulum w/ Justin
- Work with Justin/Ryan on Clean Code

Anticipated challenges





O-Drive CAN Commands

CMD ID	Name	Sender	Start Byte	Name	Type	Description
0x000	Get_Version	ODrive_Axis0	0	Protocol_Version	uint8	Always reported as 2
			1	Hw_Version_Major	uint8	hw_version_major
			2	Hw_Version_Minor	uint8	hw_version_minor
			3	Hw_Version_Variant	uint8	hw_version_variant
			4	Fw_Version_Major	uint8	fw_version_major
			5	Fw_Version_Minor	uint8	fw_version_minor
			6	Fw_Version_Revision	uint8	fw_version_revision
			7	Fw_Version_Unreleased	uint8	fw_version_unreleased
0x001	Heartbeat	ODrive_Axis0	0	Axis_Error	uinit32	<axis>.active_errors
						<axis>.disarm_reason
			4	Axis_State	uint8	<axis>.current_state
			5	Procedure_Result	uint8	<axis>.procedure_result
			6	Trajectory_Done_Flag	uint8	<axis>.controller.trajectory_done (0: Flase, 1: True)
0x002	Estop	Master	Empty Payload	-	-	ESTOP_REQUESTED
0x003	Get_Error	ODrive_Axis0	0	Active_Errors	uinit32	active_errors
			4	Disarm_Reason	uinit32	disarm_reason
0x004	RxSdo	None	0	Opcode	uint8	0: Read, 1: Write
			1	Endpoint_ID	uint16	Endpoint ID as found in flat_endpoints.json
			3	Reserved	uint8	-
			4	Value	uinit32	Data type and length depend on endpoint ID
0x005	TxSdo	None	0	Reserved0	uint8	-
			1	Endpoint_ID	uint16	Endpoint ID as found in flat_endpoints.json
			3	Reserved1	uint8	-
			4	Value	uinit32	Data type and length depend on endpoint ID
0x006	Set_Axis_Node_ID	Master	0	Axis_Node_ID	uinit32	node_id
0x007	Set_Axis_State	Master	0	0	uinit32	requested_state
0x009	Get_Encoder_Estimates	ODrive_Axis0	0	Pos_Estimate	float32	<axis>.pos_vel_mapper.pos_rel <axis>.pos_vel_mapper.pos_abs Depends on: ODrive.Controller.Config.absolute_setpoints
			4	Vel_Estimate	float32	<axis>.pos_vel_mapper.vel
0x00b	Set_Controller_Mode	Master	0	Control_Mode	uinit32	control_mode
			4	Input_Mode	uinit32	input_mode
0x00c	Set_Input_Pos	Master	0	Input_Pos	float32	input_pos
			4	Vel_FF	uint16	input_vel
			6	Torque_FF	uint16	input_torque
0x00d	Set_Input_Vel	Master	0	Input_Vel	float32	input_vel
			4	Input_Torque_FF	float32	input_torque
0x00e	Set_Input_Torque	Master	0	Input_Torque	float32	input_torque
0x00f	Set_Limits	Master	0	Velocity_Limit	float32	vel_limit
			4	Current_Limit	float32	current_soft_max
0x011	Set_Traj_Vel_Limit	Master	0	Traj_Vel_Limit	float32	vel_limit
0x012	Set_Traj_Accel_Limits	Master	0	Traj_Accel_Limit	float32	accel_limit
			4	Traj_Decel_Limit	float32	decel_limit
0x013	Set_Traj_Inertia	Master	0	Traj_Inertia	float32	inertia
0x014	Get_Iq	ODrive_Axis0	0	Iq_Setpoint	float32	Iq_setpoint
			4	Iq_Measured	float32	Iq_measured
0x015	Get_Temperature	ODrive_Axis0	0	FET_Temperature	float32	<axis>.motor.fet_thermistor.temperature
			4	Motor_Temperature	float32	<axis>.motor.motor_thermistor.temperature
0x016	Reboot	Master	Empty Payload	-	-	reboot()
0x017	Get_Bus_Voltage_Current	ODrive_Axis0	0	Bus_Voltage	float32	vbus_voltage
			4	Bus_Current	float32	Ibus
0x018	Clear_Errors	Master	Empty Payload	-	-	clear_errors()
0x019	Set_Absolute_Position	Master	0	Position	float32	set_abs_pos()
0x01a	Set_Pos_Gain	Master	0	Pos_Gain	float32	pos_gain
0x01b	Set_Vel_Gains	Master	0	Vel_Gain	float32	vel_gain
			4	Vel_Integrator_Gain	float32	vel_integrator_gain
0x01c	Get_Torques	ODrive_Axis0	0	Torque_Target	float32	effective_torque_setpoint
			4	Torque_Estimate	float32	torque_estimate

O-Drive CAN Python Class

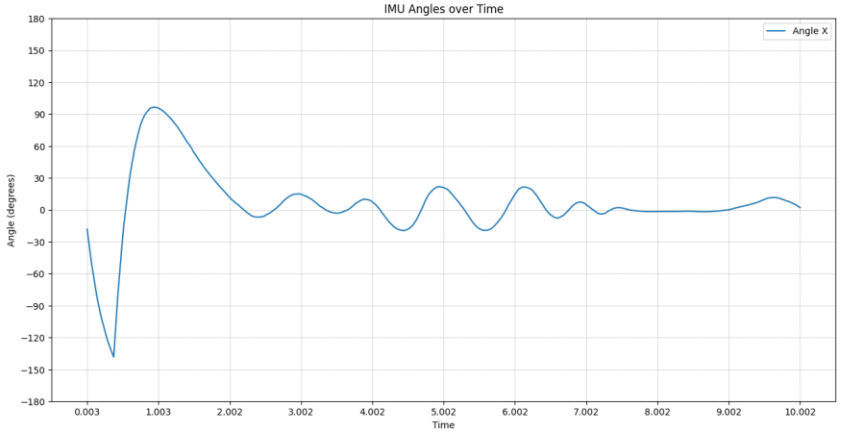
Started on the code layout:

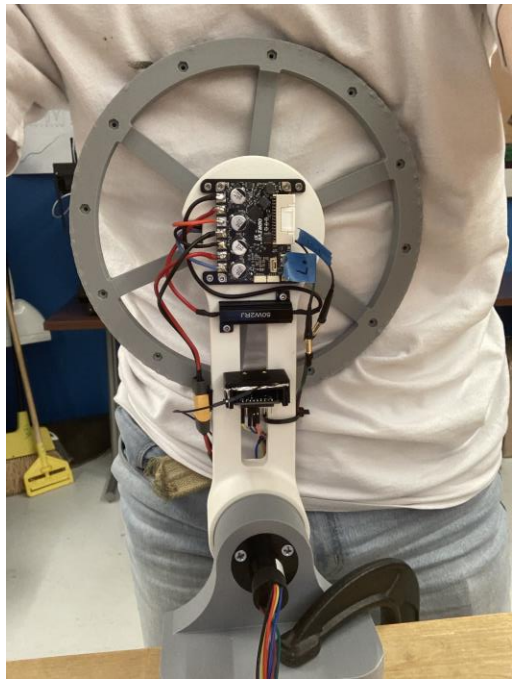
- Maybe need some help with this code!

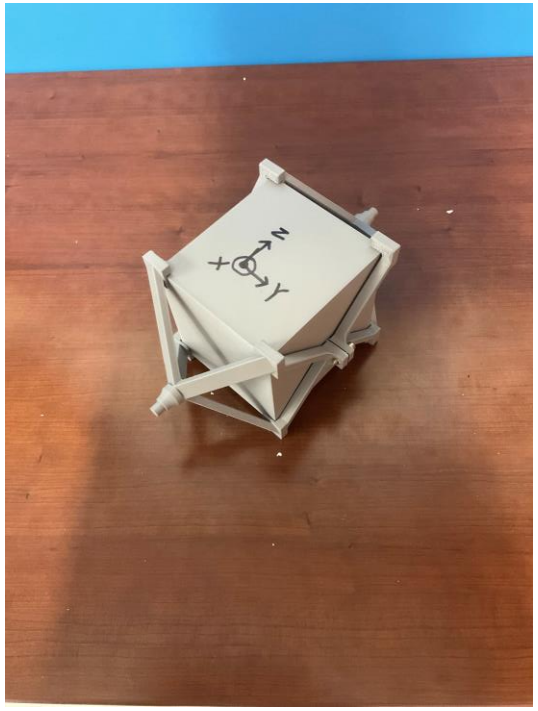
```python
import board
import can


class ODriveCAN:
    """
    A class for setting up O-Drive motor controllers using CAN comunincation

    Attributes:
        Specifically for setting up CAN comunication between Raspberry Pi and CAN Communication Type:
            canBusID (String): Can Bus ID should be default "can0" but if you have muilitiple can buses
            on your device you can modify here

            canBusType (String): python-can package CAN communication type we by default us "socketcan"

        O-Drive Controller Specific Attributes:
        nodeID (integer): The node ID can be set by the
    """
    def __init__(self, canBusID, canBusType, nodeID):
        self.canBusID = canBusID
        self.canBusType = canBusType
        self.nodeID = nodeID


    def setAxisNodeID(self):
        """
        Sets Axis NodeID for an O-Drive Controller through CAN BUS

        Set_Axis_NodeID: 0x06
        """

        pass

    def setAxisState(self):
        """
        Set Axis State for an O-Drive Controller through CAN BUS


        CAN Set_Axis_State: 0x07
            Axis_Requested_State:
                Undefined:                          0x0
                Idle:                               0x1
                Startup_Sequence:                   0x2
                Full_Calibration_Sequence:          0x3
                Motor_Calibration:                  0x4
                Encoder_Index_Search:               0x5
                Encoder_Offset_Calibration:         0x6
                Closed_Loop_Control:                0x7
                Lockin_Spin:                        0x8
                Encoder_DIR_Find:                   0x9
                Homing:                             0xA
                Encoder_Hall_Polarity_Calibration:  0xB
                Encoder_Hall_Phase_Calibration:     0xD
        """
        pass
```

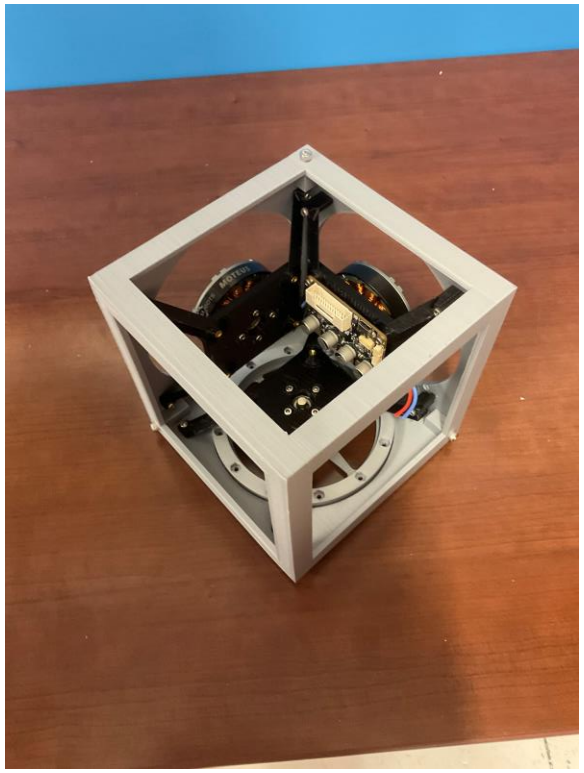
```python
def setControllerMode(self):
        """
        Set the O-Drive Controller Mode type

        Attribute:
            CAN Set_Controller_Mode: 0x0B
                    Control_Mode:
                        Voltage_Control:   0x0
                        Torque_Control:    0x1
                        Velocity_Control:  0x2
                        Position_Control:  0x3

                    Input_Mode:
                        Inactive:      0x0
                        Passthrough:   0x1
                        VEL_Ramp:      0x2
                        Pos_Filter:    0x3
                        Mix_Channels:  0x4
                        Trap_Traj:     0x5
                        Torque_Ramp:   0x6
                        Mirror:        0x7
                        Tunning:       0x8
        """
        pass



def getAxisEncoderEstimates(self):
    """
    Get Encoder Estimates for specific O-Drive Controller Axis through CAN BUS

    CAN Get_Encoder_Estimates: 0x09
                - Pos_Estimate
                - Vel_Estimate

    Attributes:
        Axis_ID


    Returns:
        Pos_Estimate
        Vel_Estimate
    """
    pass
```

Visual System Updates









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[Assignee] + [Task Title]

Progress completed this past week

-[Discuss progress]

-Highlight based on: Complete, >50%, <50%

Goals for next week

-[Discuss goals]

Anticipated challenges

-[discuss challenges, request assistance if needed]

[Relevant photos if needed]

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