ERSOW ROBOTIC TEAM

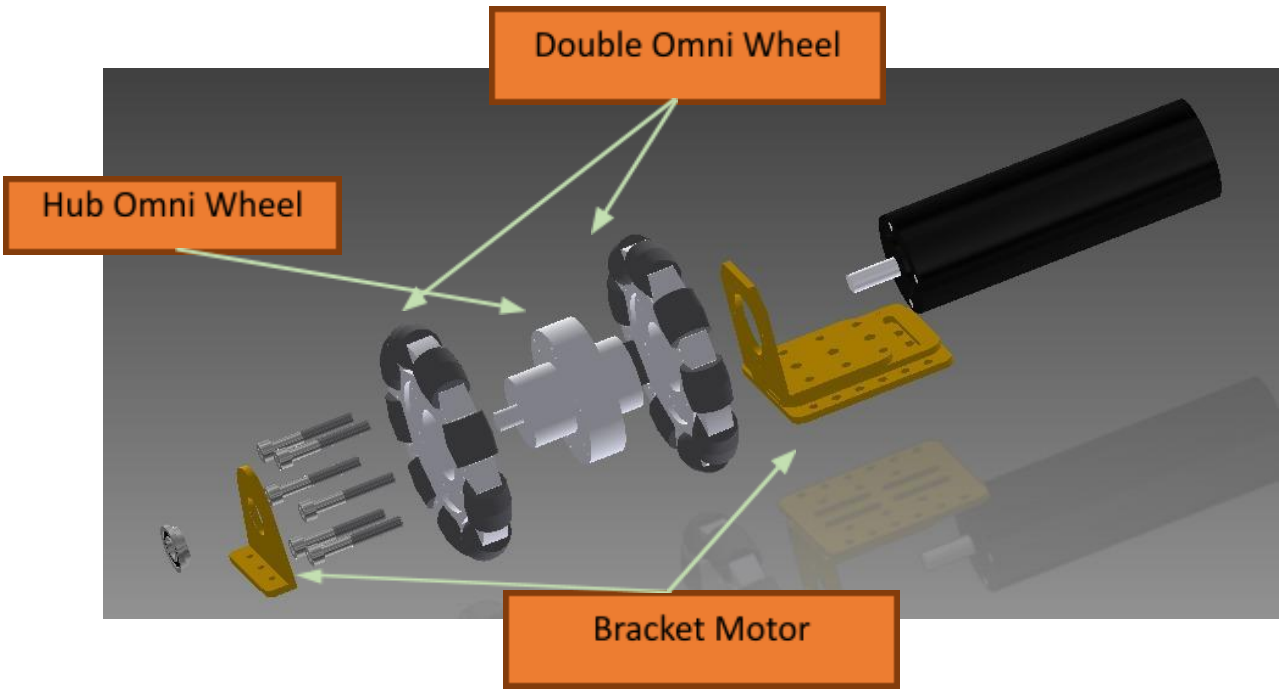
Mechanical and Electrical Description with SoftwareArchitecture

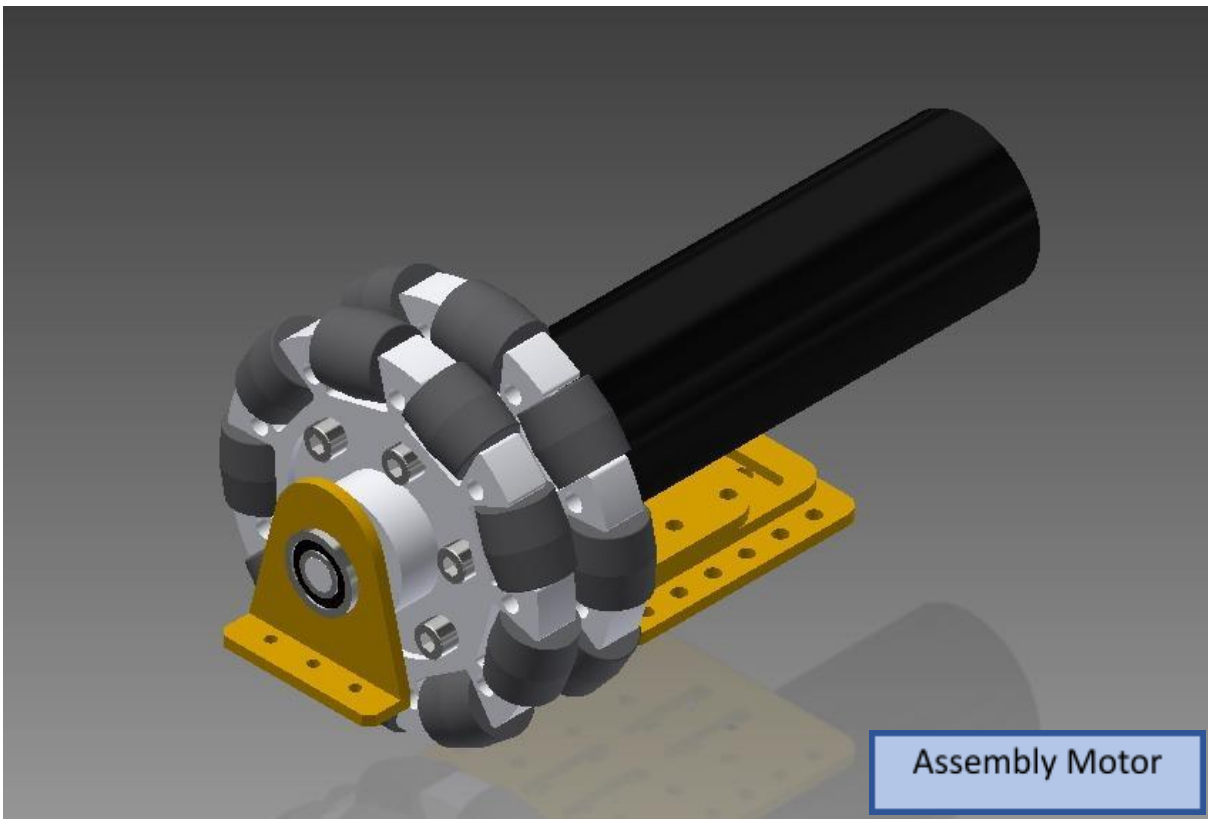
1. Mechanical Structure

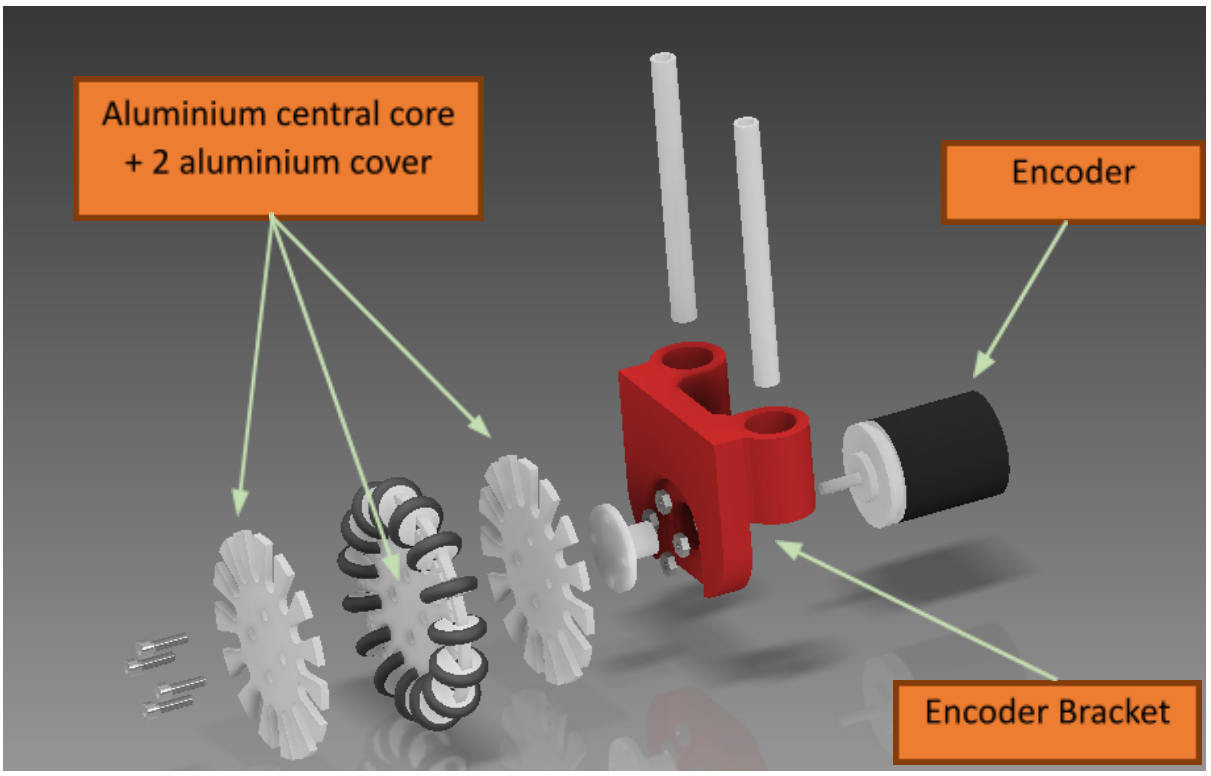
1.1 Mechanical System Overview

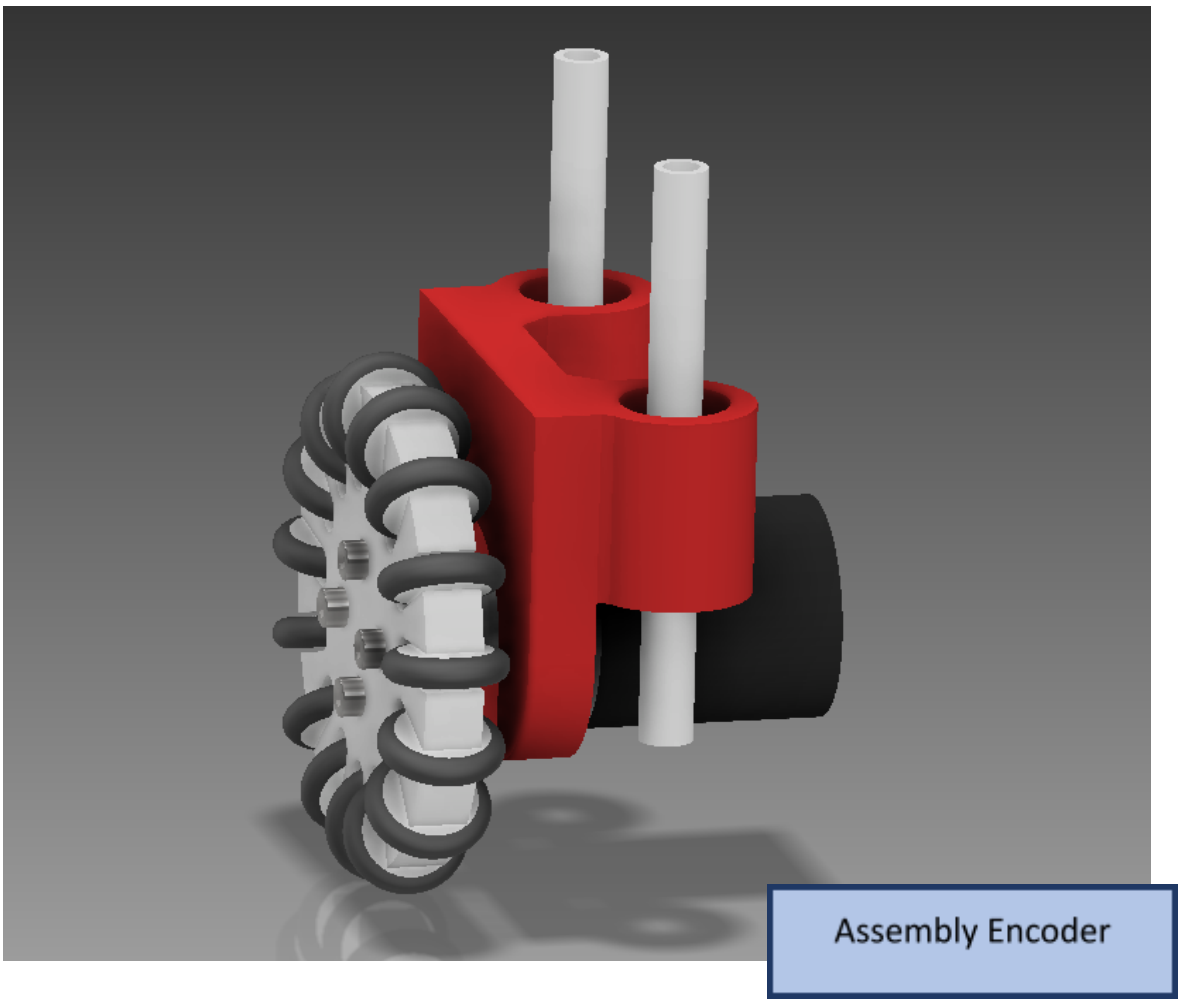
The new design of the ERSOW robot is made considering the strengths and weaknesses of the old robots. Improvements include better optimization of robot size and weight. Thus, the new ERSOW robot is an improved version of the previous robot. Our robot has dimensions of 44 cm x 44 cm x 71.5 cm and weight 27, the reduction in the dimensions of this robot is done to lighten the weight of the robot so as to increase the speed of the robot. Part of our robot is made of an aluminum sheet which is cut according to the design using a CNC machine. This material composes almost all the mechanical parts of the robot. In our robot, we have 3 base levels. The bottom base itself is where the robot's driving mechanism uses 4 wheels and there are 3 wheels connected to a rotary encoder that functions to measure the movement of the robot, which will take data where and how far the robot moves. Base 2 is the kicking mechanism and hardware. And the top base is the place for a personal laptop, a dribbling mechanism, and a vision mechanism from the robot.

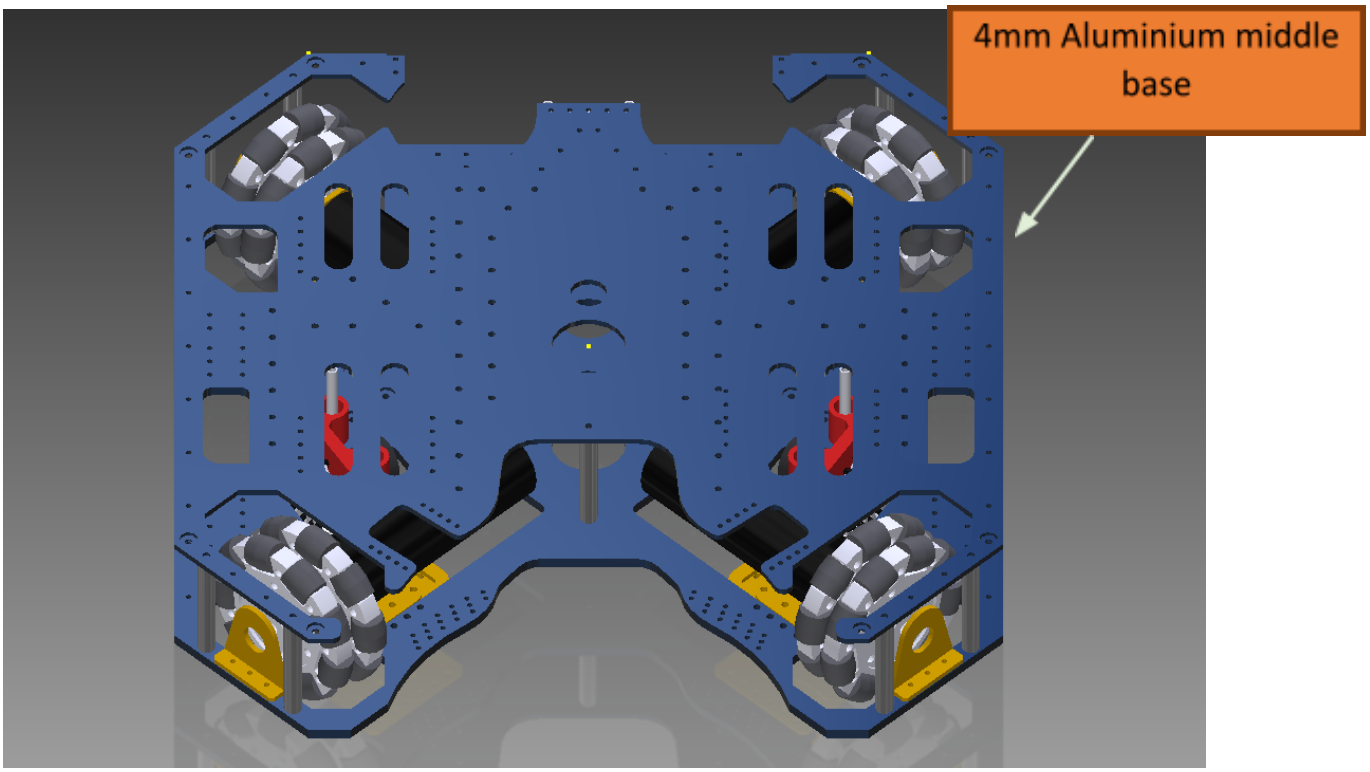
1.1. Robot Design

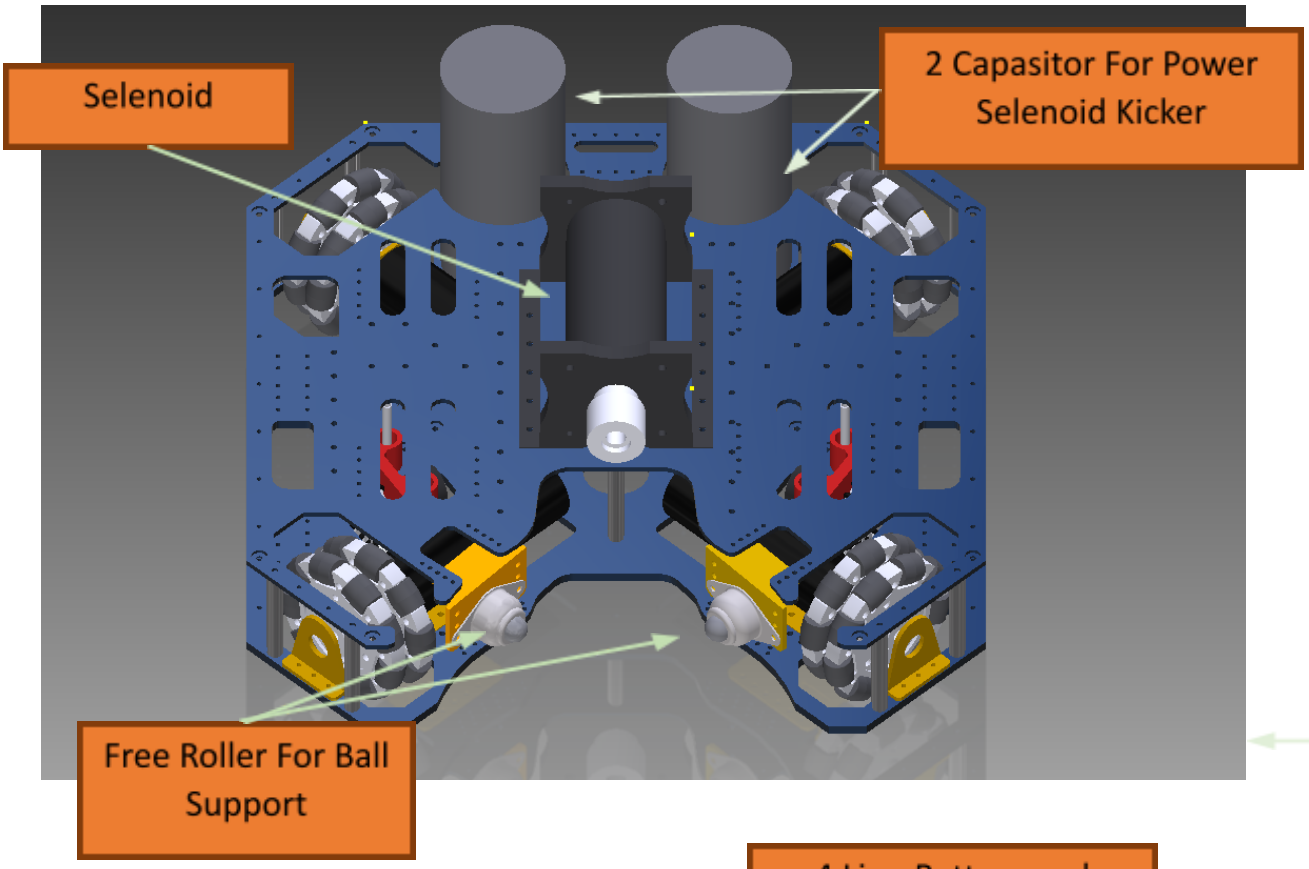


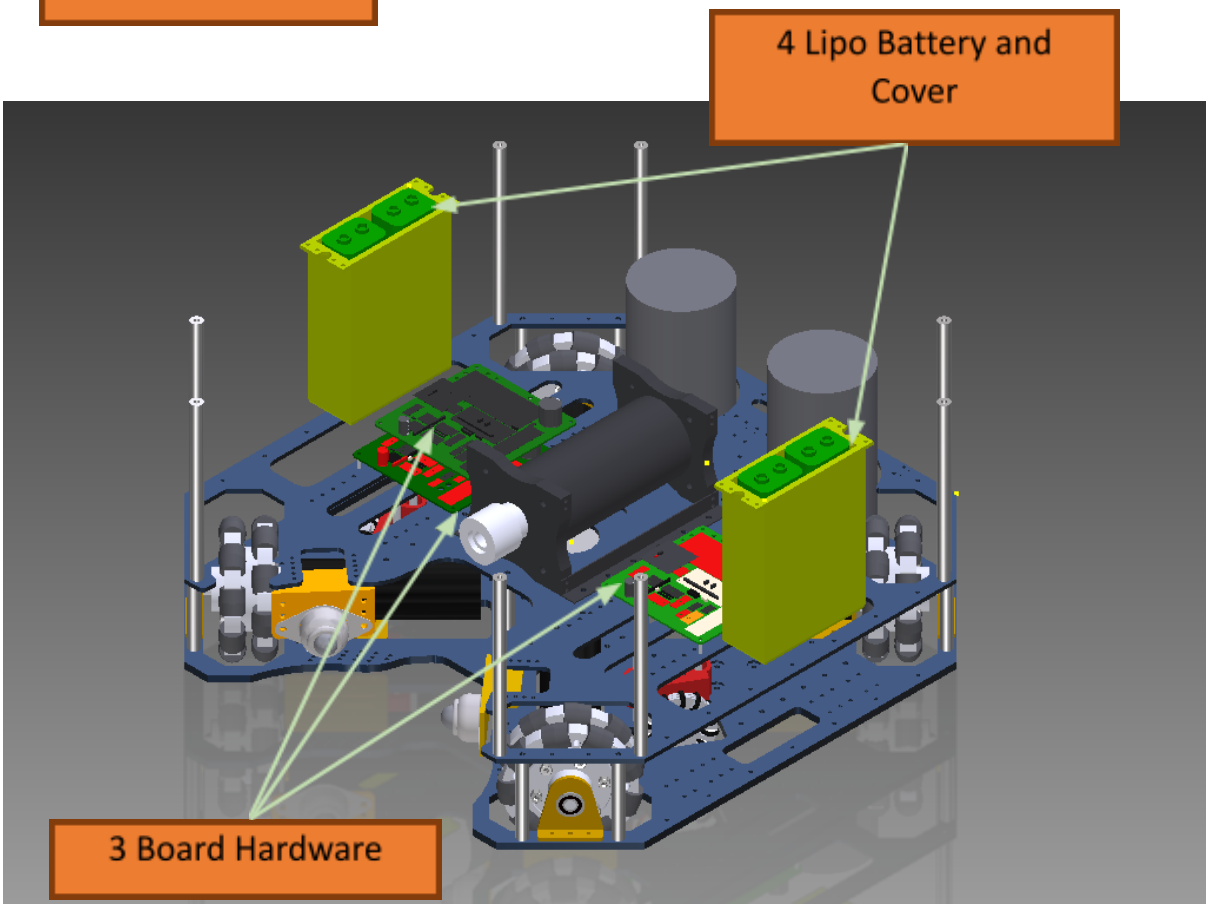

Assembly Motor

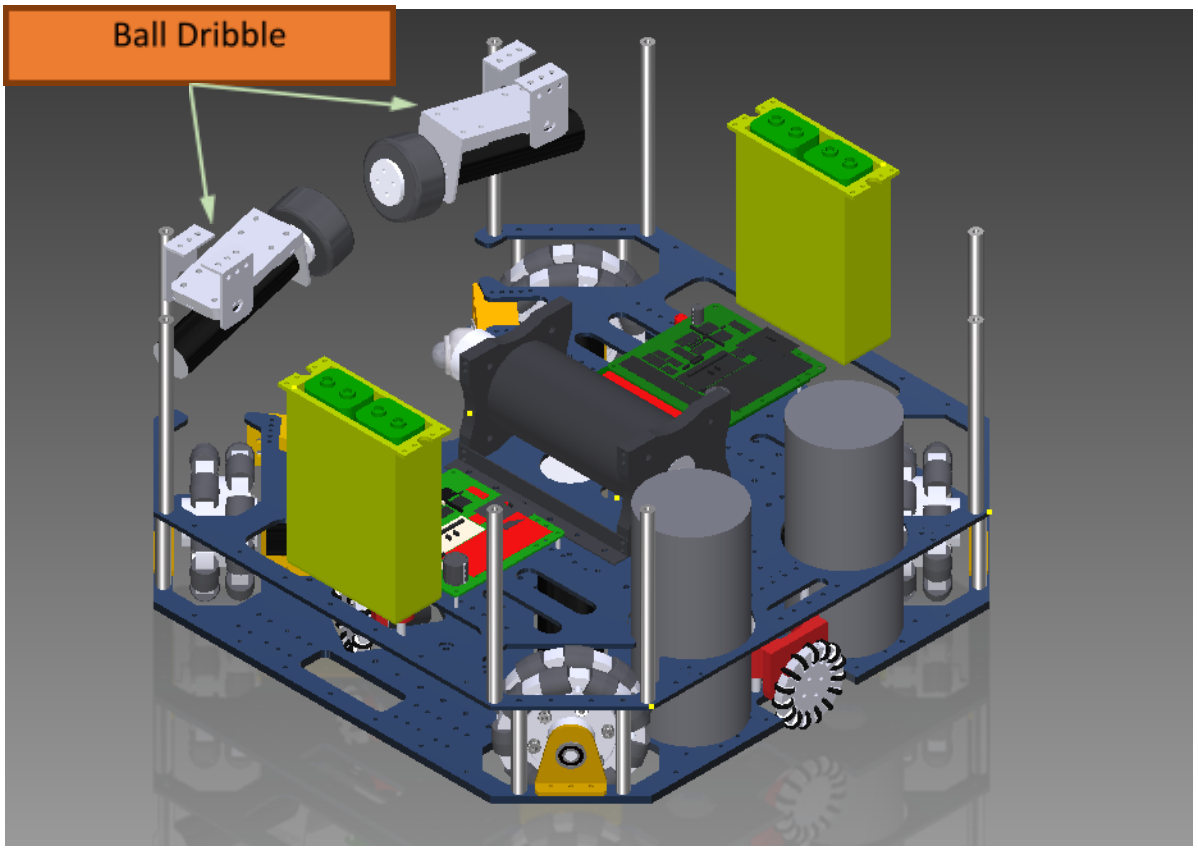

Aluminium central core
+ 2 aluminium cover
Encoder
Encoder Bracket

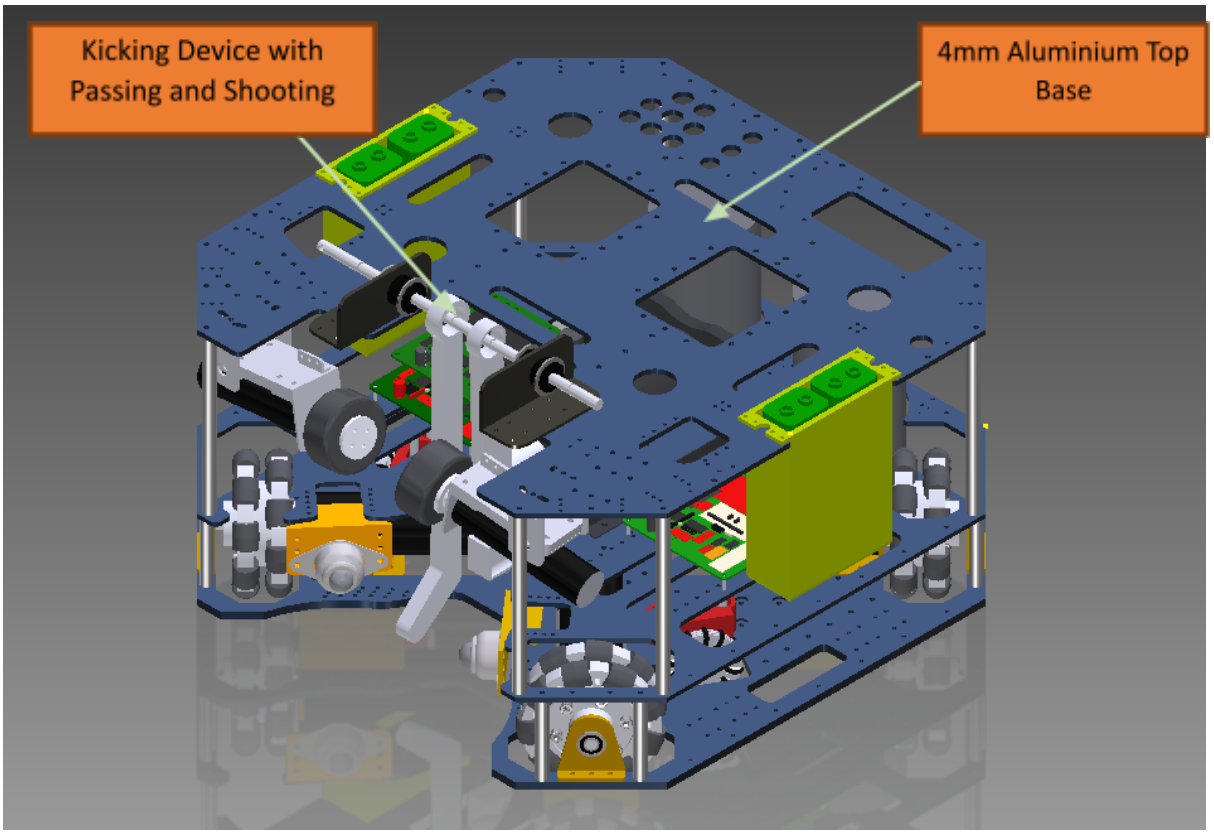

Assembly Encoder

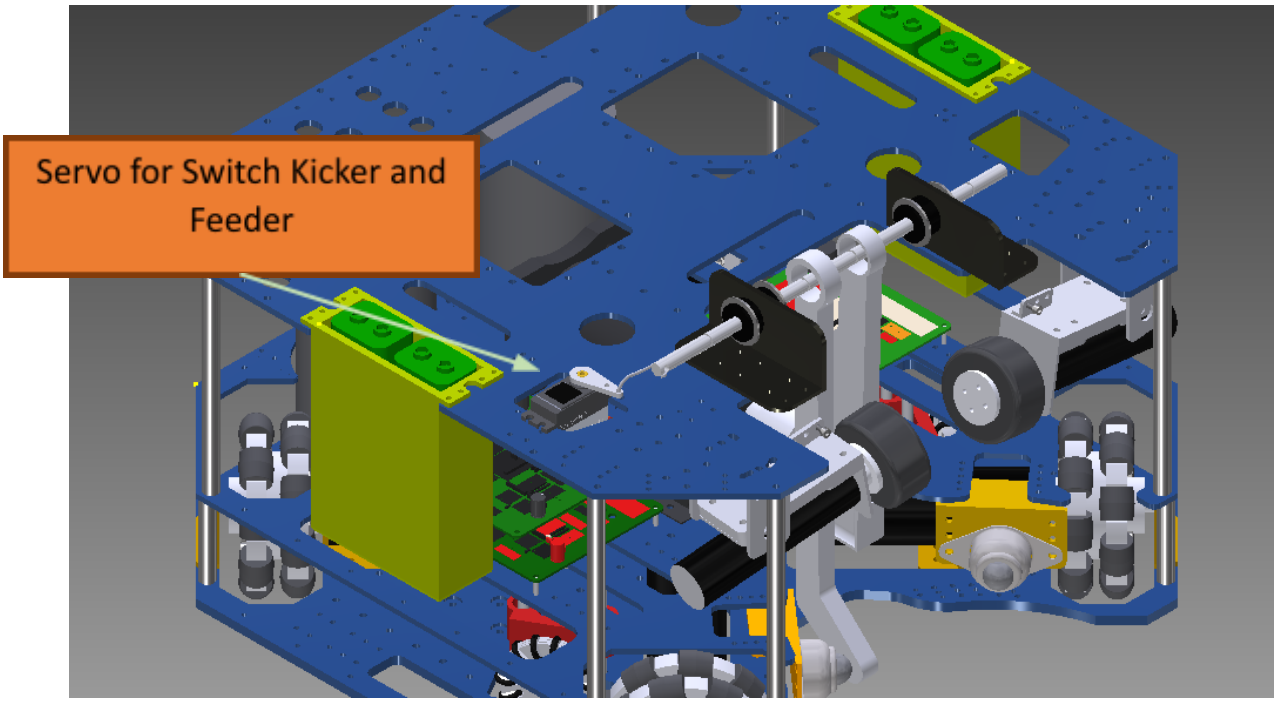

4mm Aluminium middle base

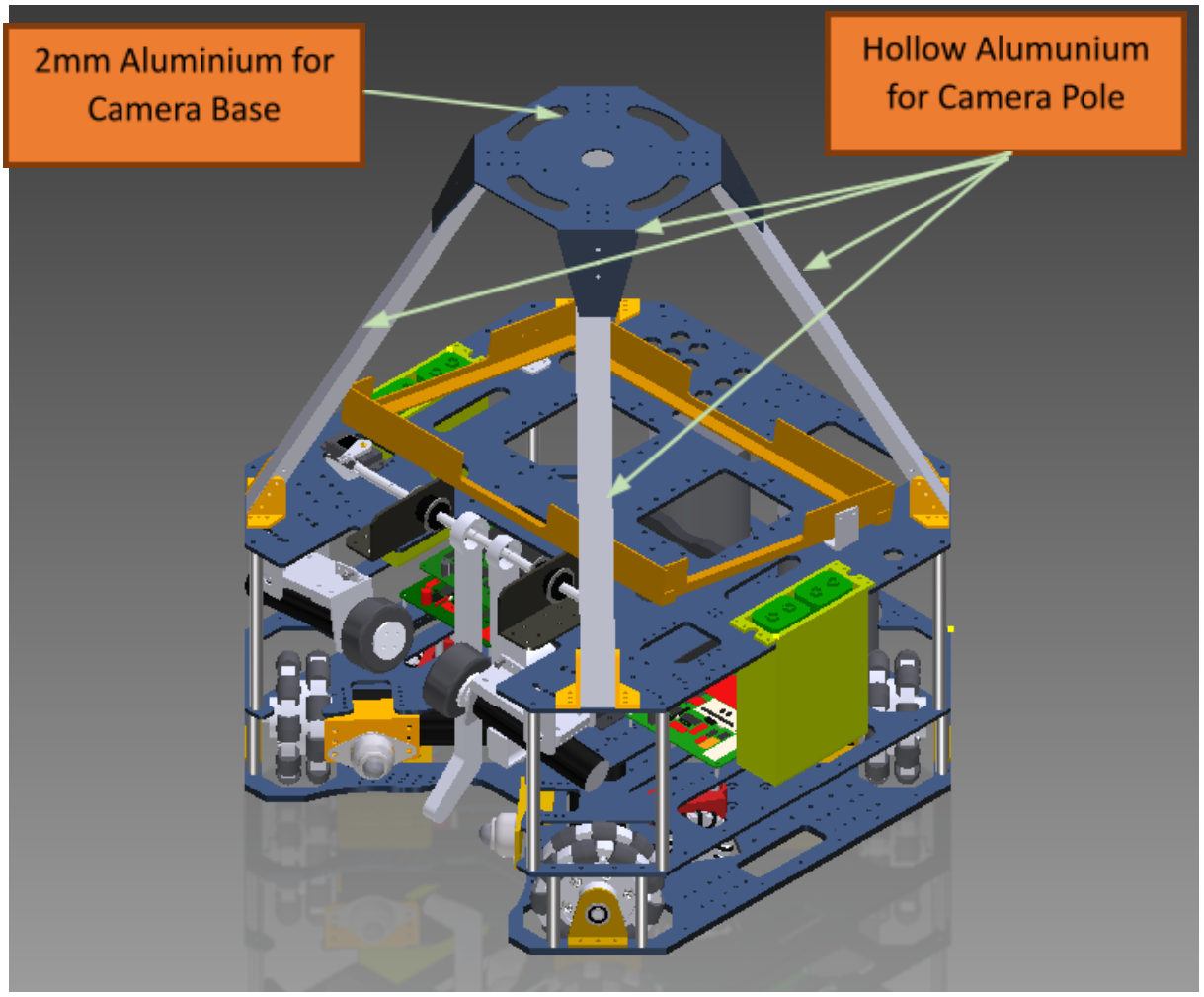

Selenoid
2 Capasitor For Power Selenoid Kicker
Free Roller For Ball Support

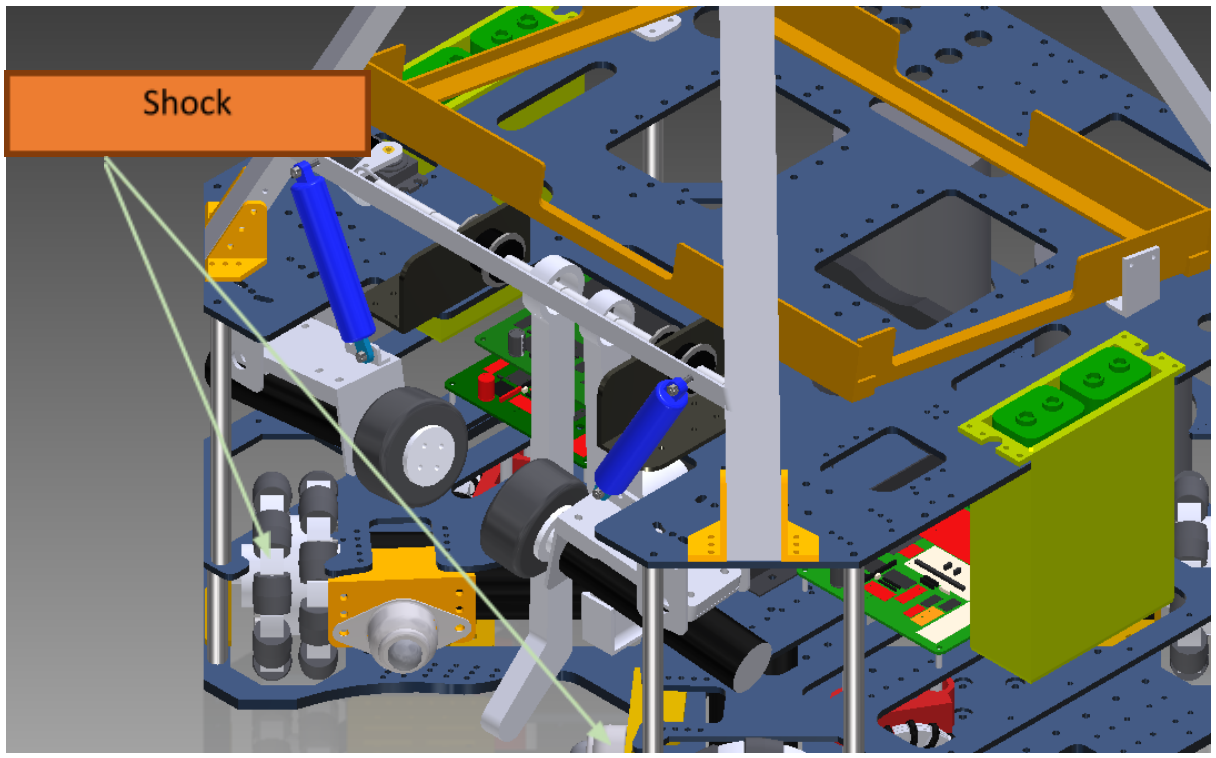

4 Lipo Battery and Cover
3 Board Hardware

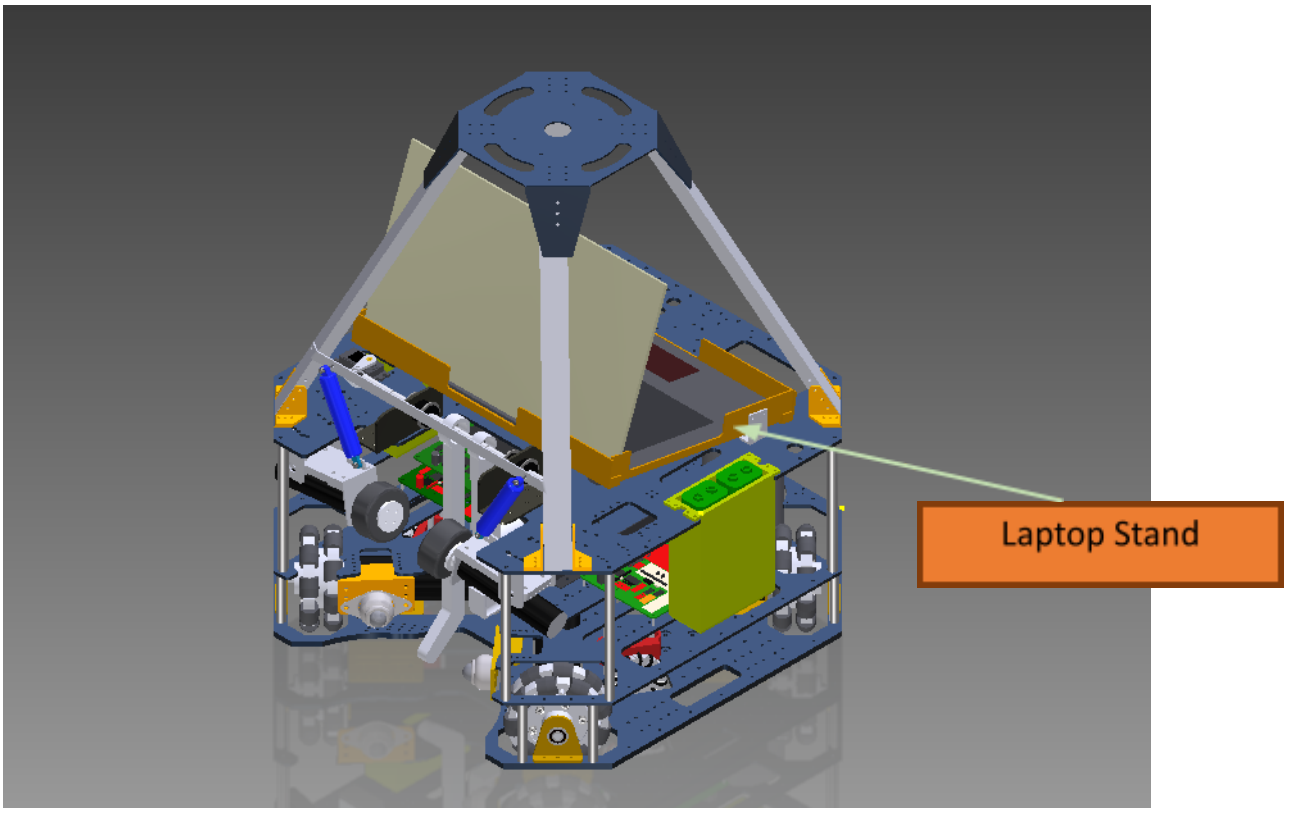

Ball Dribble

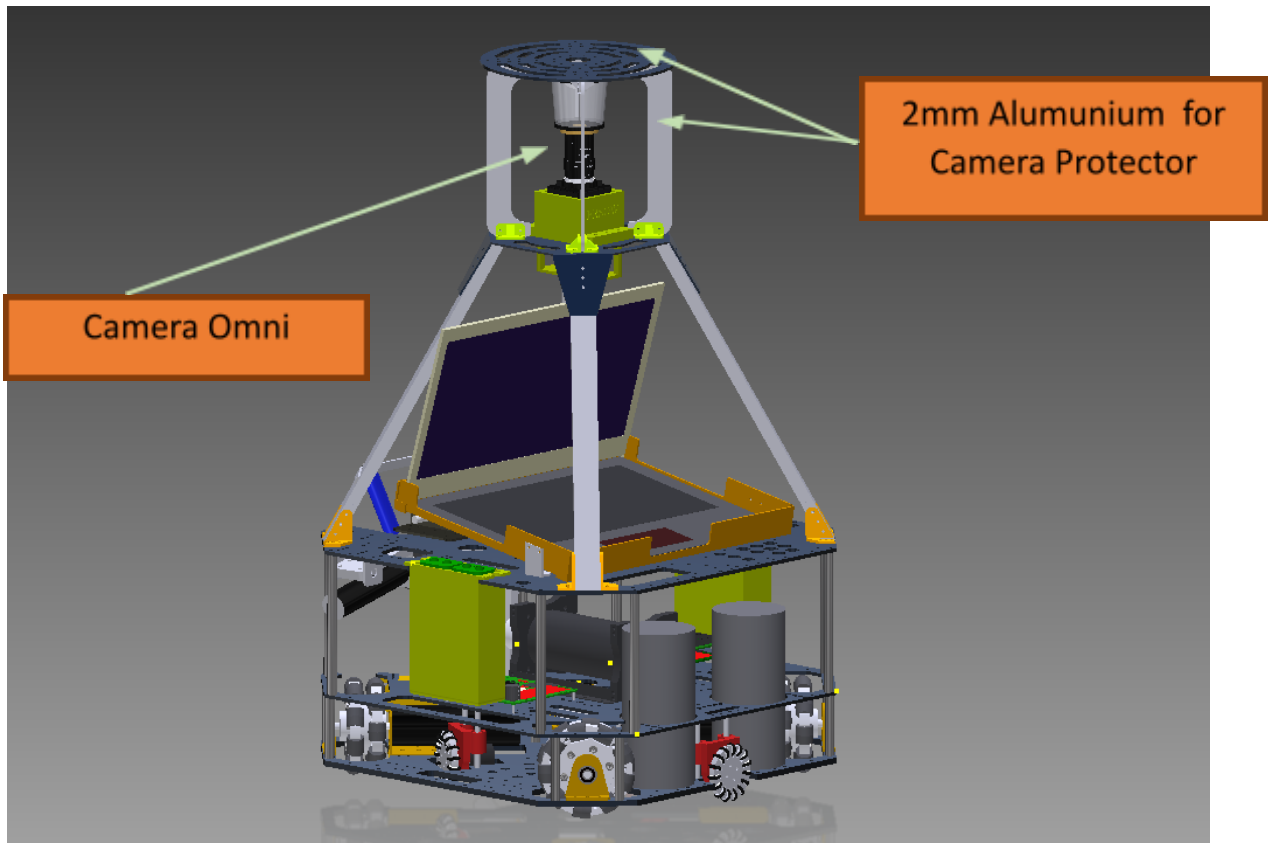

Kicking Device with Passing and Shooting
4mm Aluminium Top Base

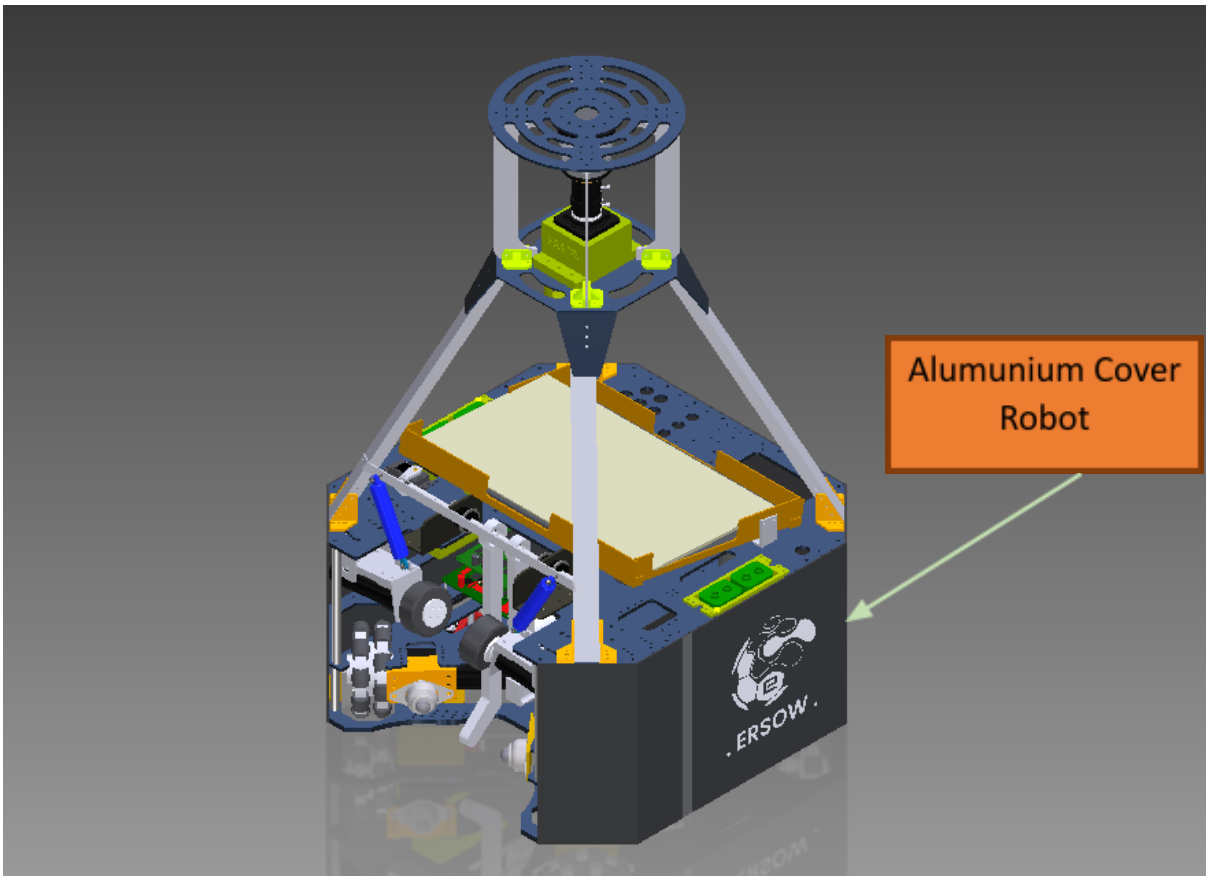

Servo for Switch Kicker and Feeder

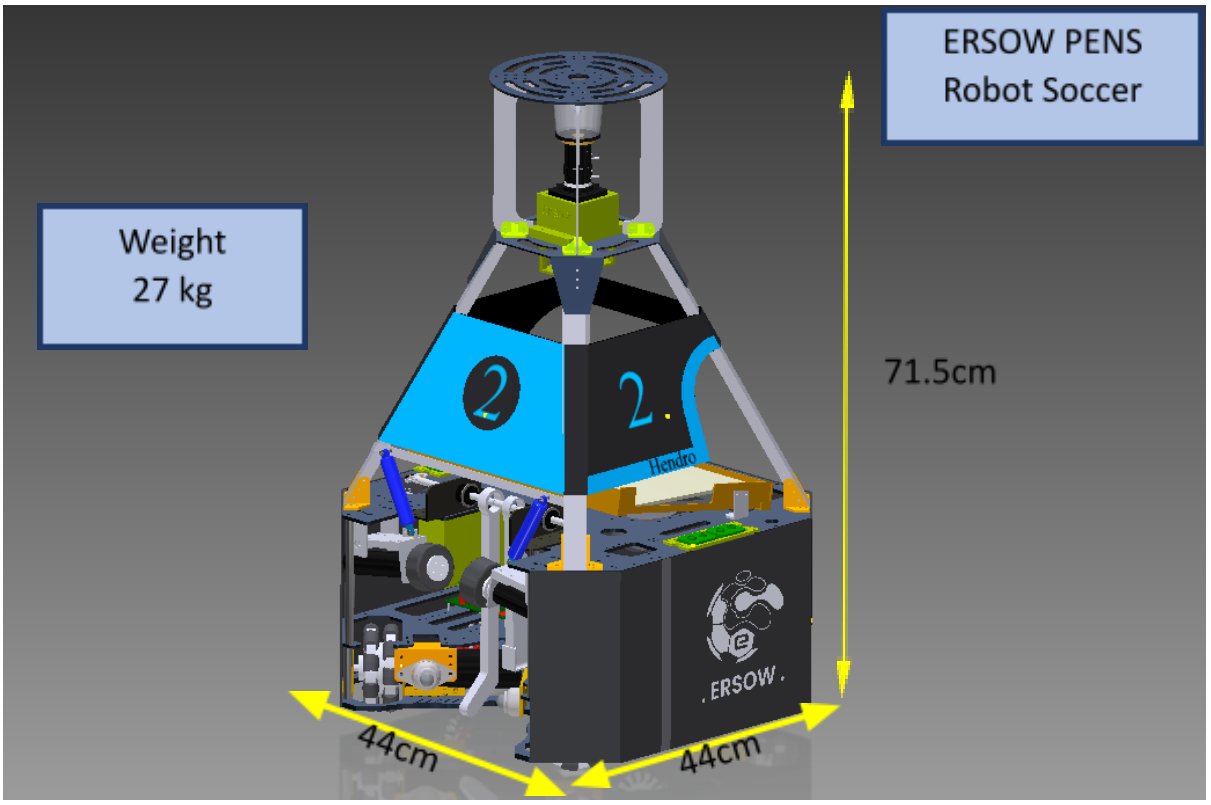

2mm Aluminium for Camera Base
Hollow Alumunium for Camera Pole


Shock


Laptop Stand

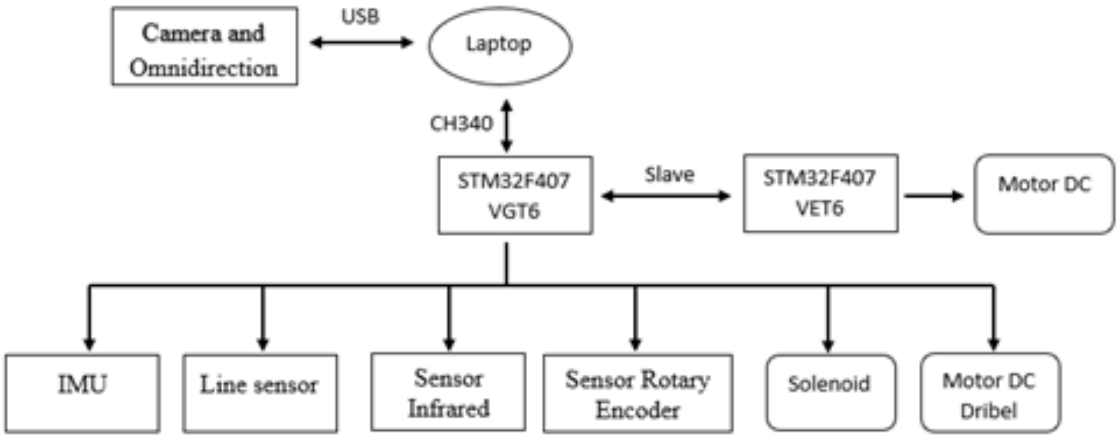

2mm Alumunium for Camera Protector
Camera Omni


Alumunium Cover Robot
ERSOW



2. Electrical Structure

The electrical system of the Ersow robot currently consists of 3 PCB boards which are used to support the robot controller. The first board is the master and control dribble, the second board is the motor driver, and the third board is the kicker. The ERSOW robot is supplied from a 3-cell li-po battery, where each robot requires 4 batteries. 1 battery is used to supply the microcontroller board, 1 battery is used to charge the capacitor with the help of a boost converter, and 2 more batteries are connected in series to supply the voltage for the robot driving motor and the ball dribbler motor. There are several sensors in the ERSOW robot, including the camera that functions as the main sensor in the robot, which is to capture all the images in the field which will later be sent to the main PC laptop for image processing. And there is also a rotary encoder sensor that functions to measure the movement of the robot which will take data in which direction and how far the robot moves. The IMU GY-25 sensor functions are to measure and provide information about speed, acceleration, orientation, and the force of gravity. Infrared sensors are used to detect whether the position of the ball is already in the robotic dribbling system. For the goalkeeper robot, there is an additional sensor in the form of an SRF distance sensor which functions as a calibration of the robot's position. The actuator on the ERSOW robot consists of a DC motor, solenoid, and servo.



The main controller of the ERSOW robot is a laptop PC, while the sub-controller uses STM32F407VGT6. The task of a Laptop PC is to process image data taken by the camera. The image will be processed to find out what objects are around the robot, namely the ball, opponent, or friend robot. In addition to processing image data from the camera, the main controller also serves as the strategic center of the robot, receiving UDP data from the base station, and sending commands to the sub-controller. As for the sub-controller, it functions to manage data from various sensors, balance the robot, and send the data to the Laptop PC serially via the CH340. The sub-controller is a liaison between the main - controller to the actuator. All information about the strategy will later be sent to the sub-controller which already contains motion data from the actuator.

3. Software Structure

We used ROS as the main system on the robot. This system connects 4 parts of the program to exchange information. These programs include Artificial Intelligence, Basestation, Vision, and Embedded. The Artificial Intelligence program handles actions or decisions from the base station based on the information provided by the Omni camera and sensor data from the embedded. The ERSOW robot uses a wireless network to communicate with the base station. Basestation provides information about orders from the referee's box, the position of friend robots, and communication between robots with one another. Thus, the ERSOW robot will act according to the specified coordination.

The strategy of the ERSOW robot depends on the challenge targets in each type of match. Generally, the ERSOW robot uses a starting position strategy, picking up the ball at the kick-off point, kicking the ball towards a friend robot, dribbling, and shooting the ball towards the opponent's goal. The method of taking the ball is based on the distance from the closest robot position to the ball position. Vision will provide ball detection information, obstacles, and opponent robots. The ERSOW robot will dribble up to the point where it is ready to shoot the ball into the goal, and the robot will take a direct kick towards the goal. The robot's displacement position will be recorded by sending rotary encoder and IMU sensor data from the embedded to AI and Basestation. Below is a flow chart of the software structure

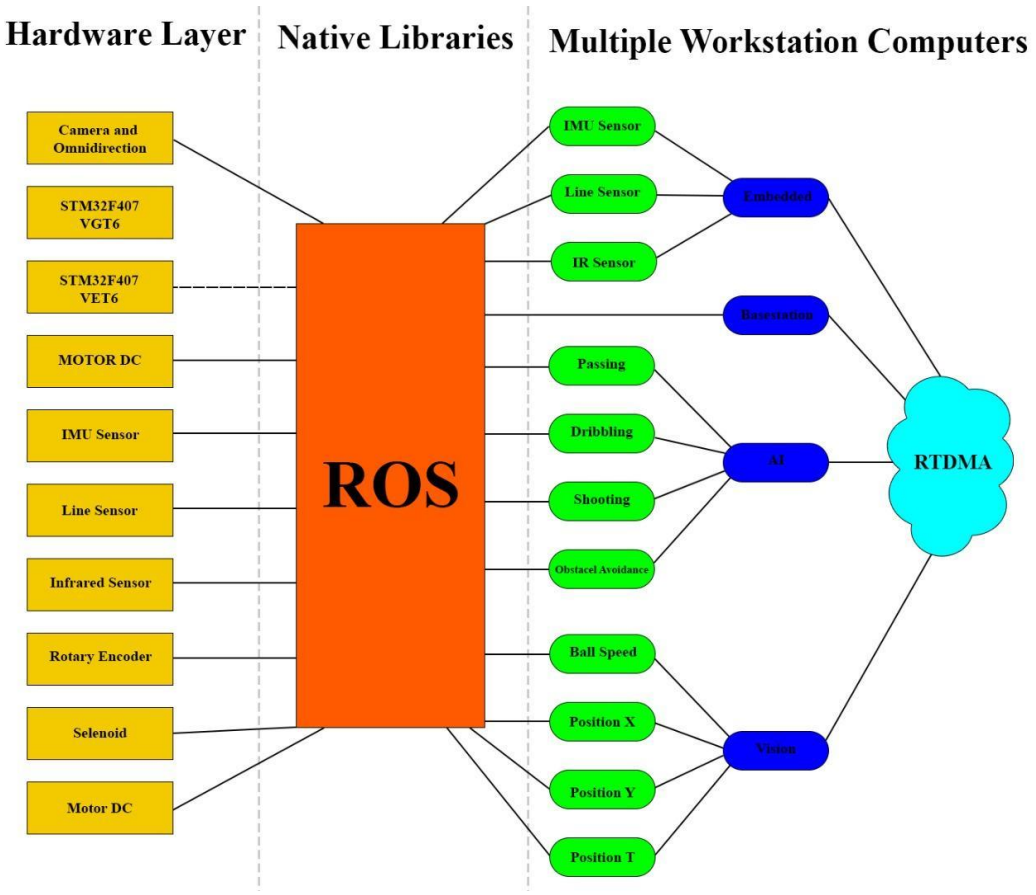


Fig. Software Structure