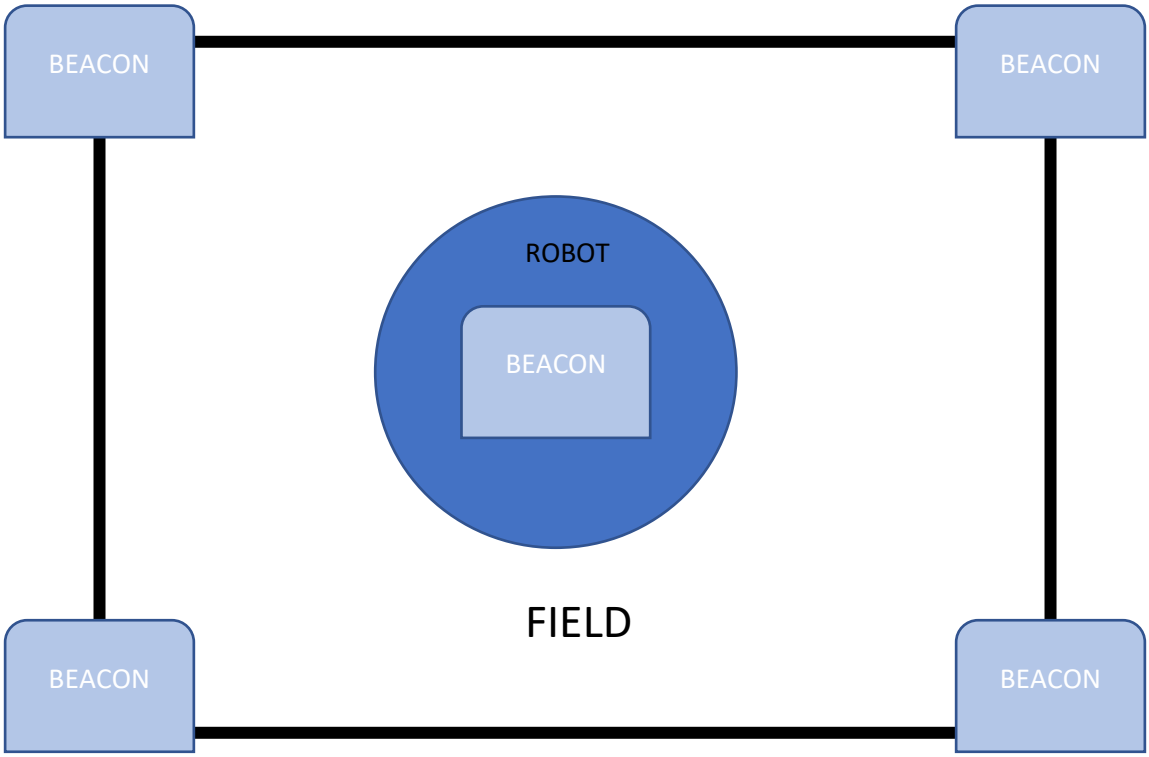
# UM Croatia

## Hardware system Explanation and Schematics

## Spatial positioning system




The spatial positioning system is needed to position the robot relative to the field. The system used is a Marvelmind indoor positioning system. It consists of a minimum of three beacons that are placed around the perimeter of the field, and one beacon that is located on the very top of each robot so that direct line of sight between the beacons can be established. The beacons allow localization of the mobile beacon within ±2 cm. The beacons can communicate with each other using a radio interface on license-free band (915/868 MHz) to triangulate their relative positions. The beacons calculate position of mobile beacon based on the propagation delay of ultrasonic signal emitted from the mobile beacon. The mobile beacon provides location data as well as IMU data to the Central processing unit.

## Mobility and dribbling system

The omni wheel system of our robot uses 4 1000W BLDC motors that are controlled by Vedder's Electronic Speed Controllers (VESC). Robot's dribbler is also controlled by the same system. VESCs communicate with the Central processing unit (Jetson NANO) through a CAN bus. The power for the motors is provided by 2 packs of 6 cell li-po batteries connected in series.

## Kicker system

The kicker of our robot uses an Arduino which gets commands from the central processing unit (Jetson NANO). The Arduino controls the kicker by sending information to VESCs which control the trigger motor, the pre-loading motor and the kicker height motor. The pre-loading motor stores energy by using a mechanical system to stretch elastic bands behind the kicking foot. The trigger motor is responsible for pulling the trigger and starting the kick. The kicker height motor controls the vertical position of the kicker. The information of readiness of the kicking motion is given by two limit switches.

The Arduino that is used to control the kicker, also is used as a relay between the Central processing unit and Inertial Measurement Unit (IMU). IMU is used to determine robot orientation in the world coordinate system.

## Object tracking system

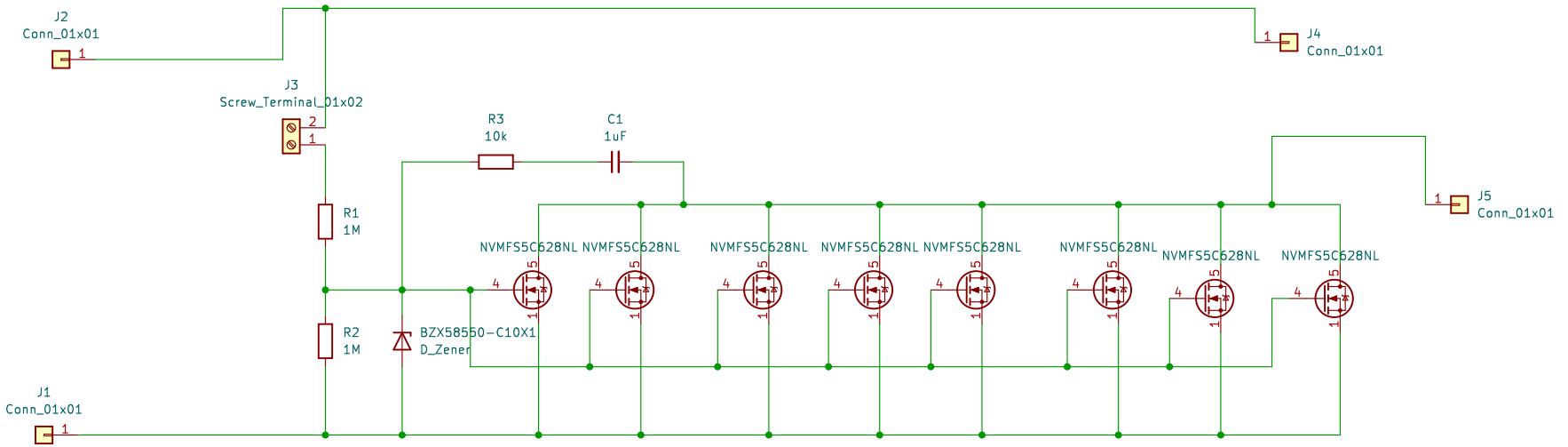
Object tracking system consists of a 360 degrees FOV camera that is mounted on the top of the robot, and a Kinect that is mounted front facing about halfway between the dribbler and the camera. The camera is used to track objects around the robot, while the Kinect is primarily used to determine the distance to the ball when the robot is facing it. Camera and Kinect are connected to the Central processing unit via USB cables.

# Power supply for the JETSON computer

Power supply we have developed works on the same principle as the standard ATX power supply for computers. It takes some input voltage and changes its value on the output using a transformer. We are using the SMPS(switch mode power supply) working principle because the galvanic isolation the transformer provides is required for safety measures. The main microchip sends a high frequency PWM (Pulse width modulation) signal to the MOSFET that turns the primary of the primary of the transformer on and off. That signal is then rectified and regulated at the output(secondary).

# Anti-spark switch

Anti-spark switch is a MOSFET based switching circuit, whose advantage over traditional ways of closing circuits in high current circuits is protection from sparking. Our anti-spark switch uses eight N-channel high current MOSFETs with their sources connected (same as their drains) to switch more current than would otherwise be possible with only one. Their gates are simultaneously controlled by one Zener diode which regulates the voltage on MOSFET gates to be constant 9.1V. The Zener diode is provided voltage through a simple net of two resistors that create a voltage divider for the diode and are responsible for the low current flow through the diode. The whole diode-resistor net is enabled by a mechanical switch. The high current going through the anti-spark switch creates non-negligible heating of the MOSFETS and therefore it requires substantial cooling. The switch dissipates its heat through two passive coolers.

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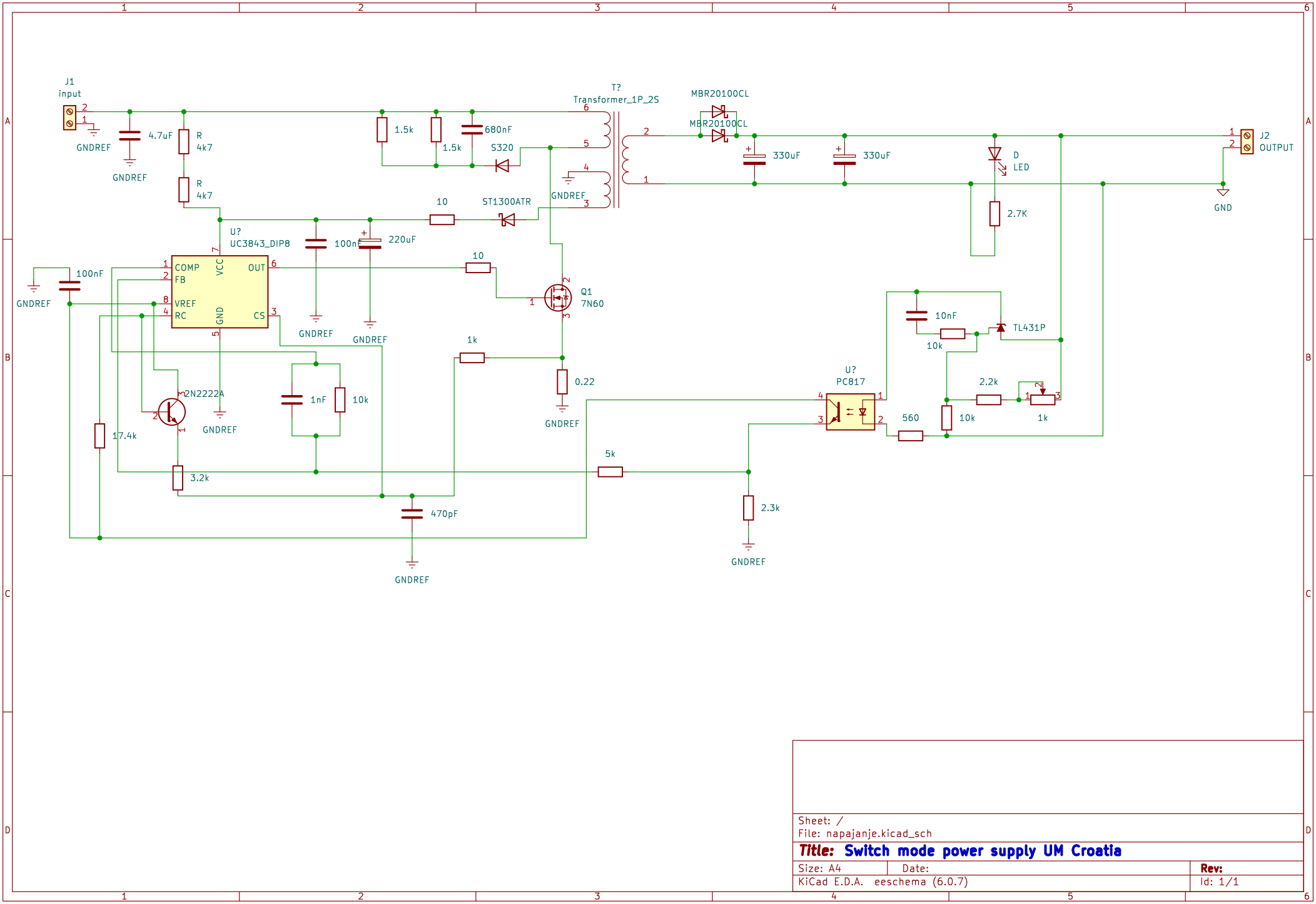


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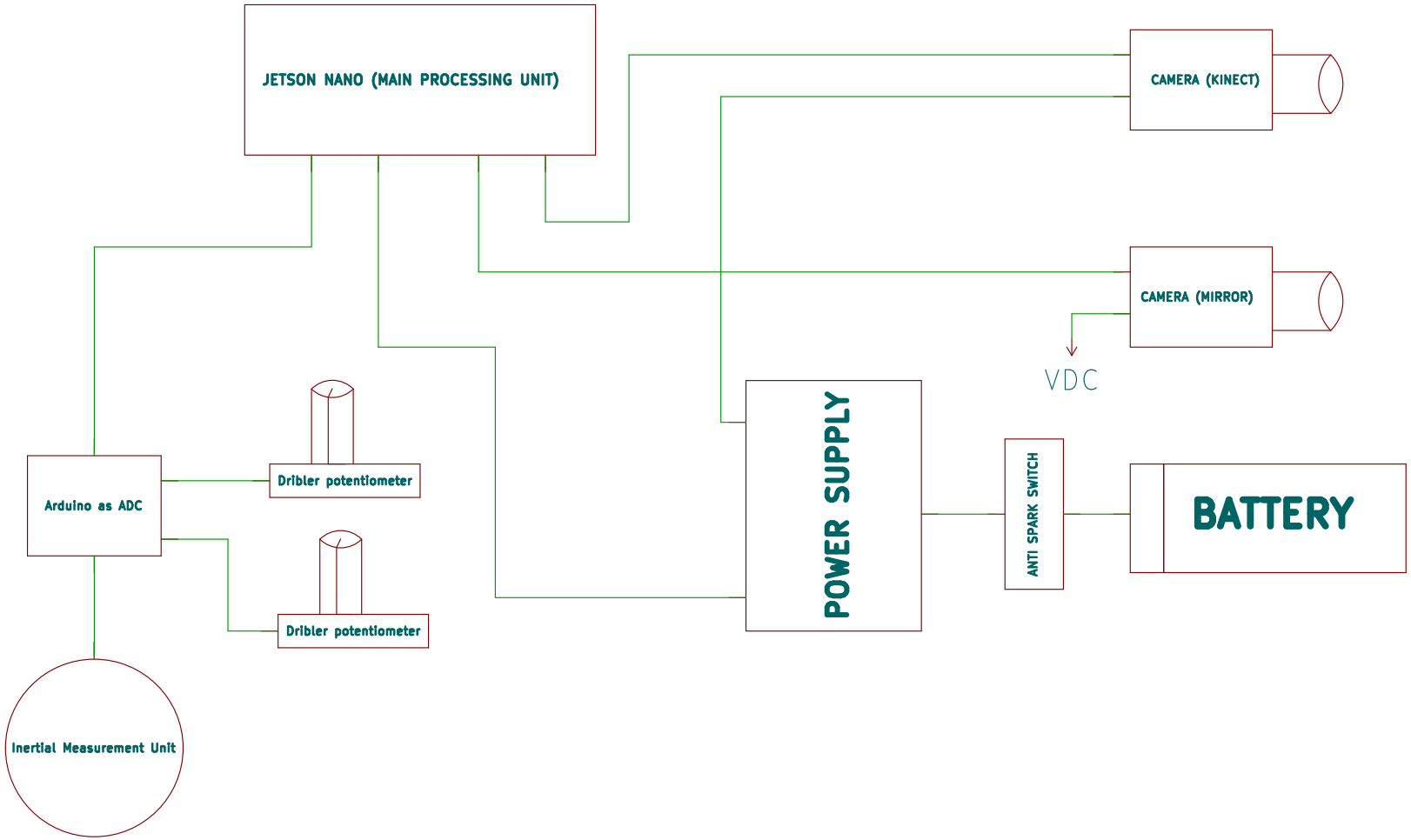
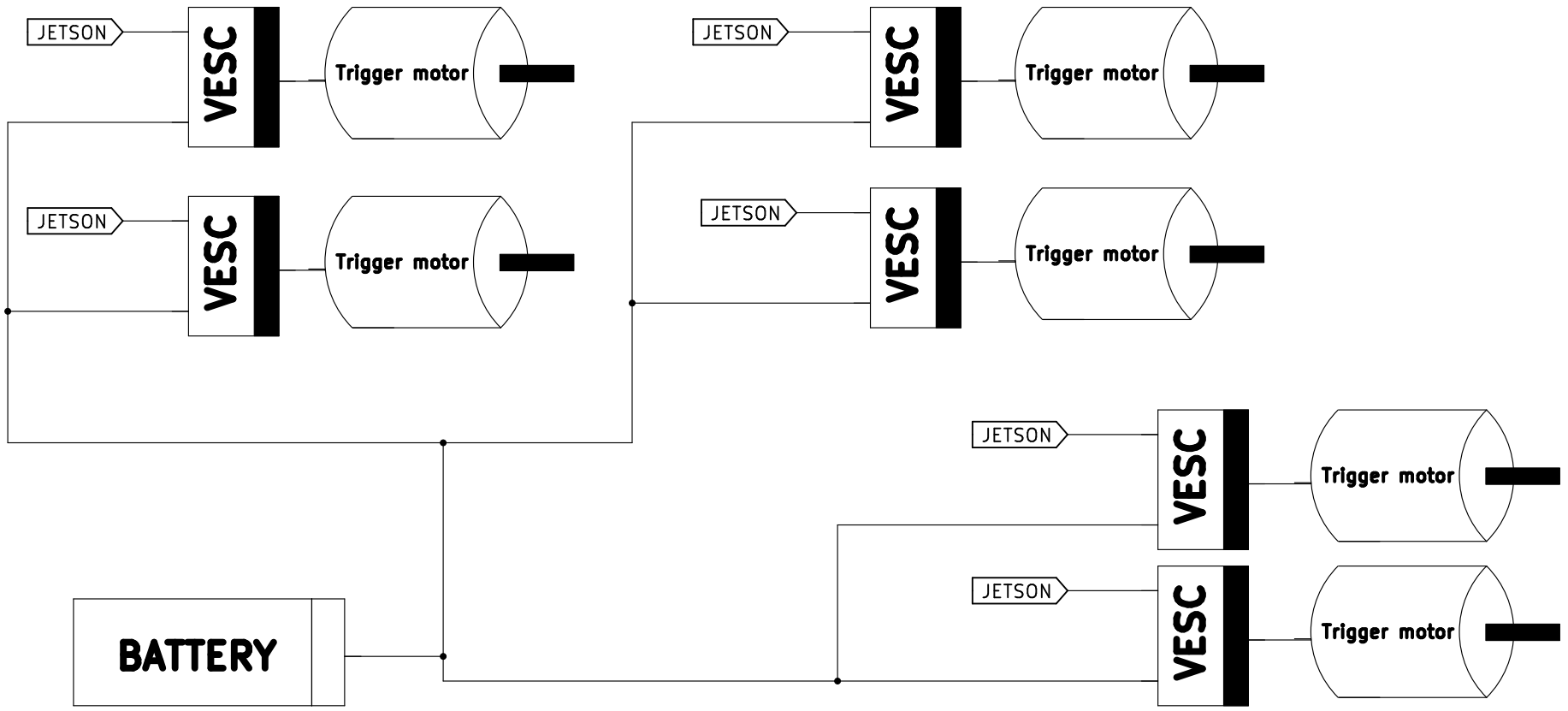



**Optical and inerial system**

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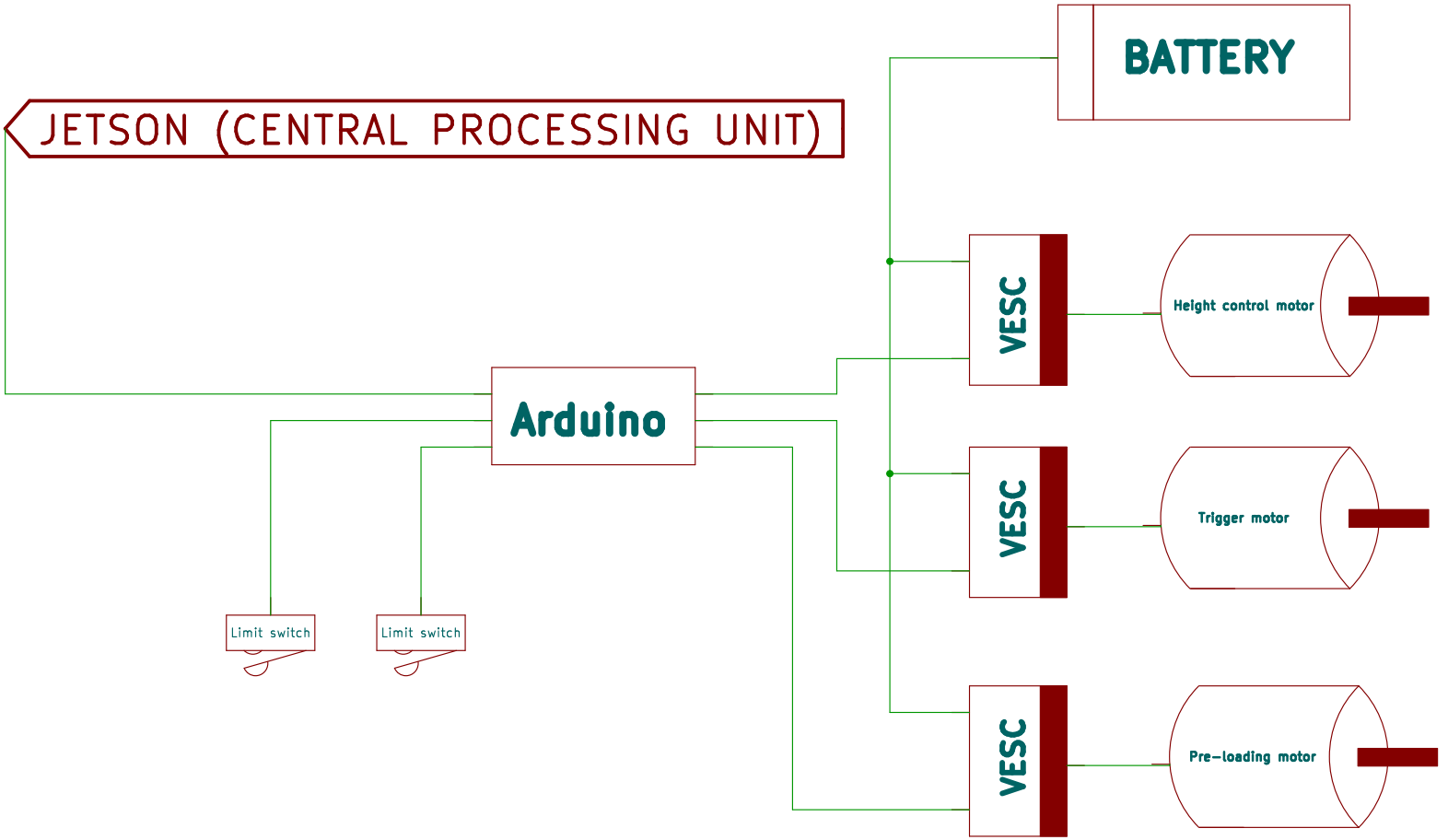


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