# Team Black Ops: Black Box Acquisition

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## Mission Objective

A weather balloon carrying a payload with hazardous material has landed on the sandy shore of a lake. In order to track the location of the payload, a "Blackbox" will emit a detectable infrared signal.

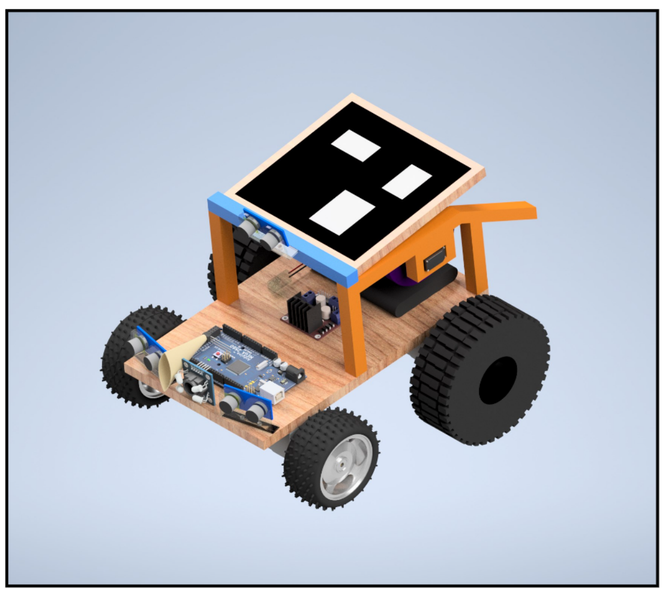
The mission is to engineer an Over Sand Vehicle (OSV) able to :

- Clear rocky terrain
- Navigate to within 250mm of the black box locator beacon
- Touch the black box locator beacon with the OSV
- Place an Aruco marker on or within 50mm of the black box locator beacon and transmit the location
- Measure and correctly transmit the color of the LED light on the black box locator beacon

Mission constraints include:

- Mass must not exceed 2.5kg
- Dimensions of OSV no more than 300mm x 300mm
- Must complete the mission in under 5 minutes
- Total bill of materials cannot exceed $320
- OSV must be fully autonomous

## Design Features

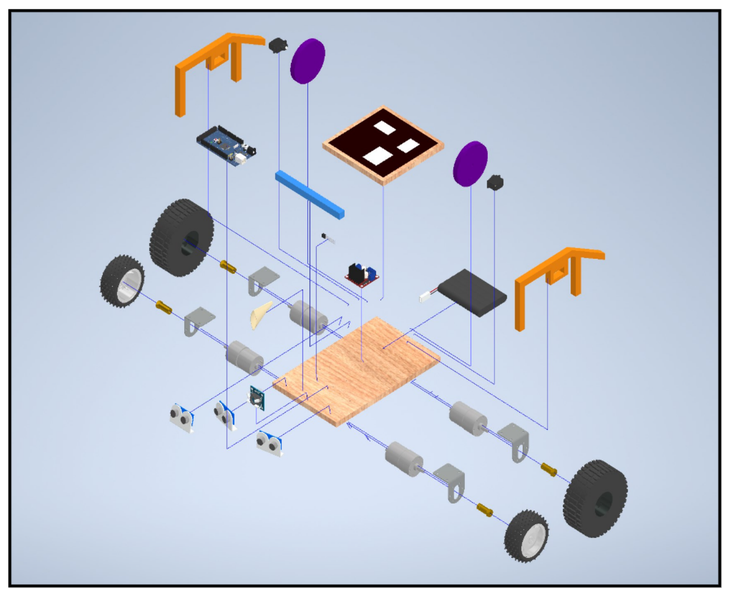


Structural

- Motors (x4): 12V / 30rpm / 137N*cm / 6mm D-shaft
- Front wheels (x2): 37mm diameter
- Rear wheels (x2): 120mm diameter
- Chassis (plywood): 160mm x 200mm x 10mm
- Mini servo motor (x2)

Electrical

- Battery (x1): 12V / 1800 mAh / NiMH
- H-bridge motor controller (x1)
- Arduino Mega
- HC-SRO4 Ultrasonic Sensor (x3)
- Infrared Sensor (x1)
- RGB Color Sensor (x1)

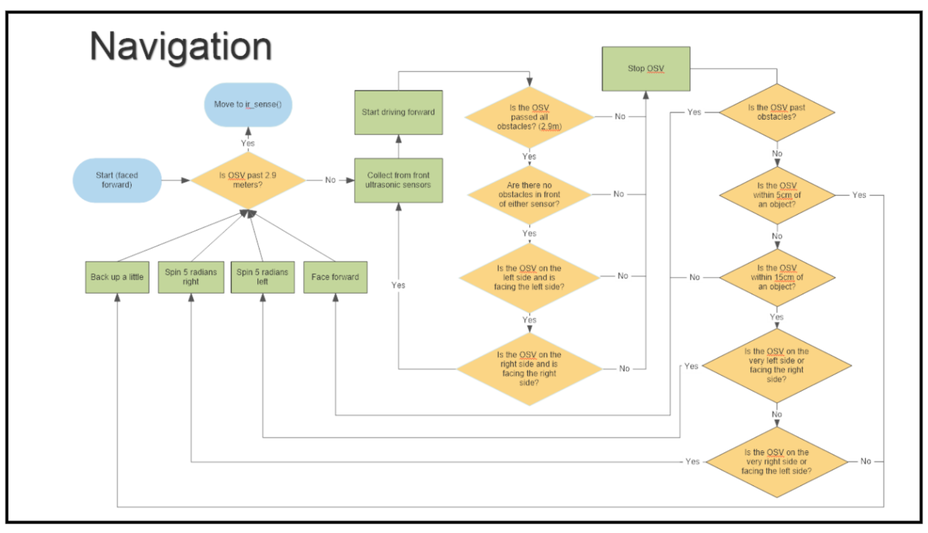


## Code Logic

Code was sectioned off into different mission-specific functions

1) Orient the OSV to face forward (using the theta given by the WiFi module)
2) Navigate through the obstacles
3) Search for the black box using the IR sensor
4) Drive as close as possible to the black box locator beacon and bump into it with the OSV
5) Position the OSV to face the side of the black box locator beacon that has the color lit up and transmit the color of the LED using the color sensor
6) Spin around and drop the Aruco marker off the back of the OSV

```
// Initialization of parameters

// All code is ran in the setup
void setup() {

  // Setup code

  spin(0);

  while (Enes100.location.x < 2.90)
    drive();

  ir_sense();
  drive_to_box();
  sense_color();
  aruco_drop();
}

// nothing in the loop (still need it to compile)
void loop() {

}
```




## Design Evolution

- Aruco marker mechanism relocated to rear of the vehicle to save space, and linear actuator replaced by wheel propulsion due to cost restraints
- Replaced Arduino Uno with Arduino Mega to have more available pins necessary to power all 5 sensors, and motor controls
- Swapped the 2 small wheels in the rear with larger wheels to increase traction
- Implemented 2 additional ultrasonic sensors for greater accuracy in object and mission site detection

## Product Performance

**Predicted**

- Successful navigation and object detection using 2 ultrasonic sensors and vision system
- IR sensor to orient the OSV towards the locator beacon once at mission sight
- 3rd ultrasonic sensor to detect black box and RGB color sensor to read and transmit LED color
- Aruco placer triggered, releasing the Aruco marker and transmitting the location of black box

**Actual**

- Confusion with US sensors in deciding which direction to go upon detection
- OSV was not consistently able to face the side with the LED so it could not transmit the color
- Mini servo motors would not always rotate entire 180 degrees, proving unreliable in Aruco marker placement

## Conclusion

Each team member's efforts to put in the time and work to stay on task lead team Black Ops to engineer a high functioning OSV, able to perform a high scoring number of mission specific objectives during final trial runs. Communication between the differing sub-teams allowed for a smooth transition to a cohesive final product, but it was important to assign at least one member to organization and team management in order to keep on track with the milestones. As engineers moving forward, it was most important to consider every idea from all team members, and to teach each other when there was a lack of understanding in the design or building process.