Robotics Hardware Systems

Webinar

AITerraR Search & Rescue

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Main Objective

Explore areas dangerous to man regardless of terrain

Tasks

- Explore deep into caves in cracks and crevices that are too small for humans
- Able to crawl on uneven terrain and even climb stones
- Able to transport on water when faced with a situation that is not able to crawl or fly
- Able to record video feed and transmit to the user for environment assessment

Flexiblility

Small & Light

Air , Land & Water

How?

Controlled Remotely

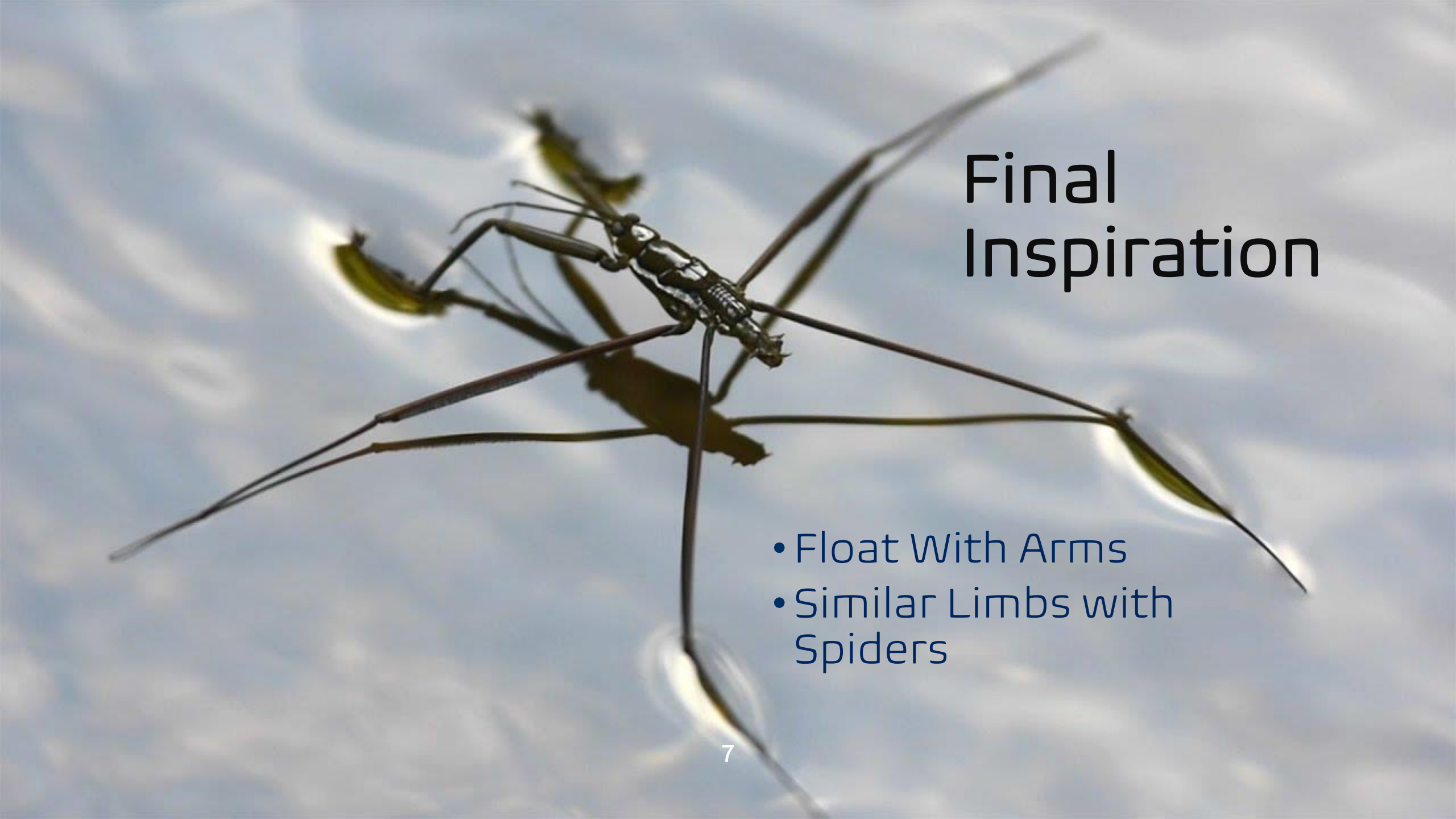
What features does this robot need in order to fulfil its desired task?

First Inspiration

- Small body
- Flexible
- Crawl up many cracks and crevices

Next Inspiration

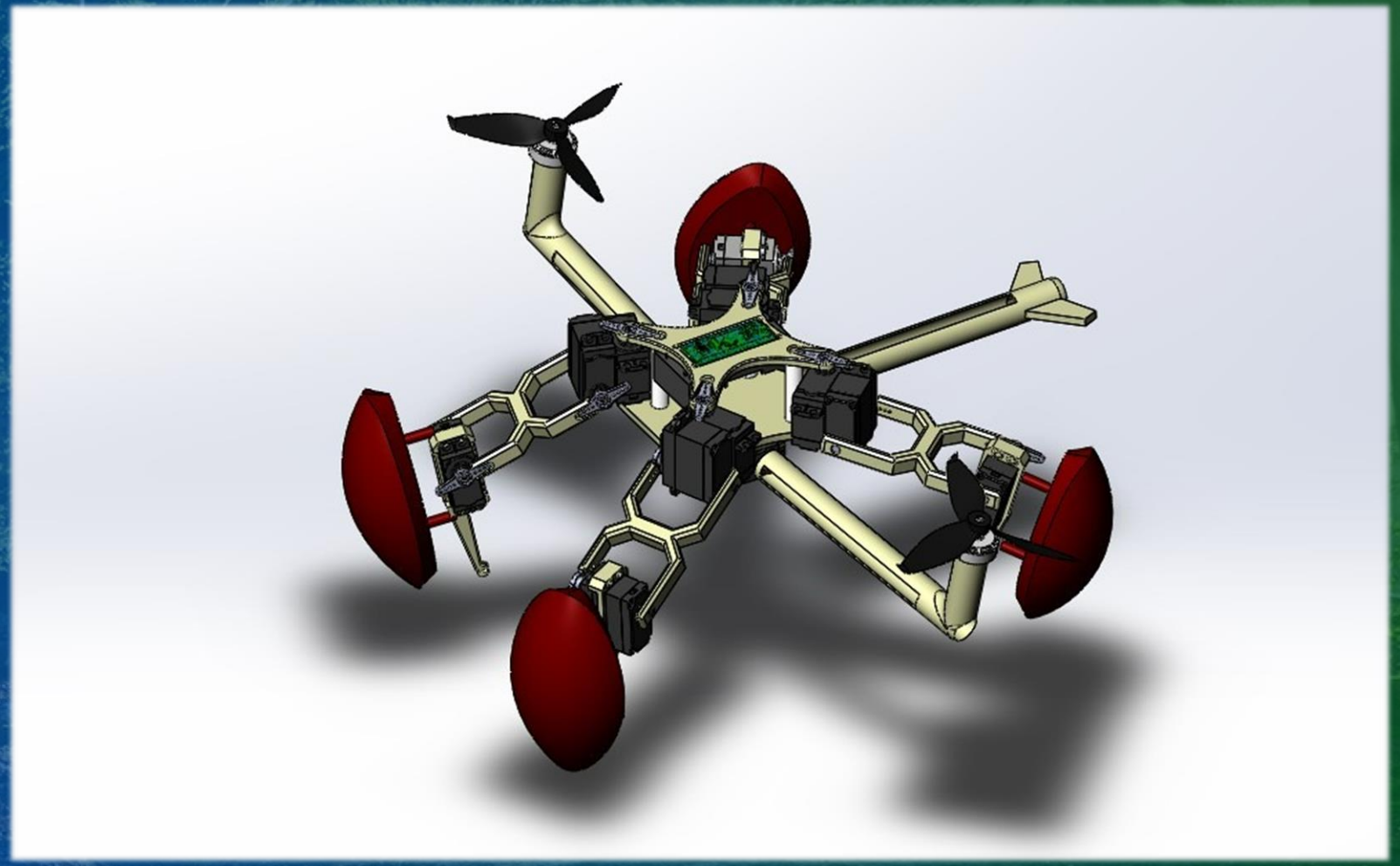
- Superb Air Control
- Thin Form Factor
- Fly Anywhere



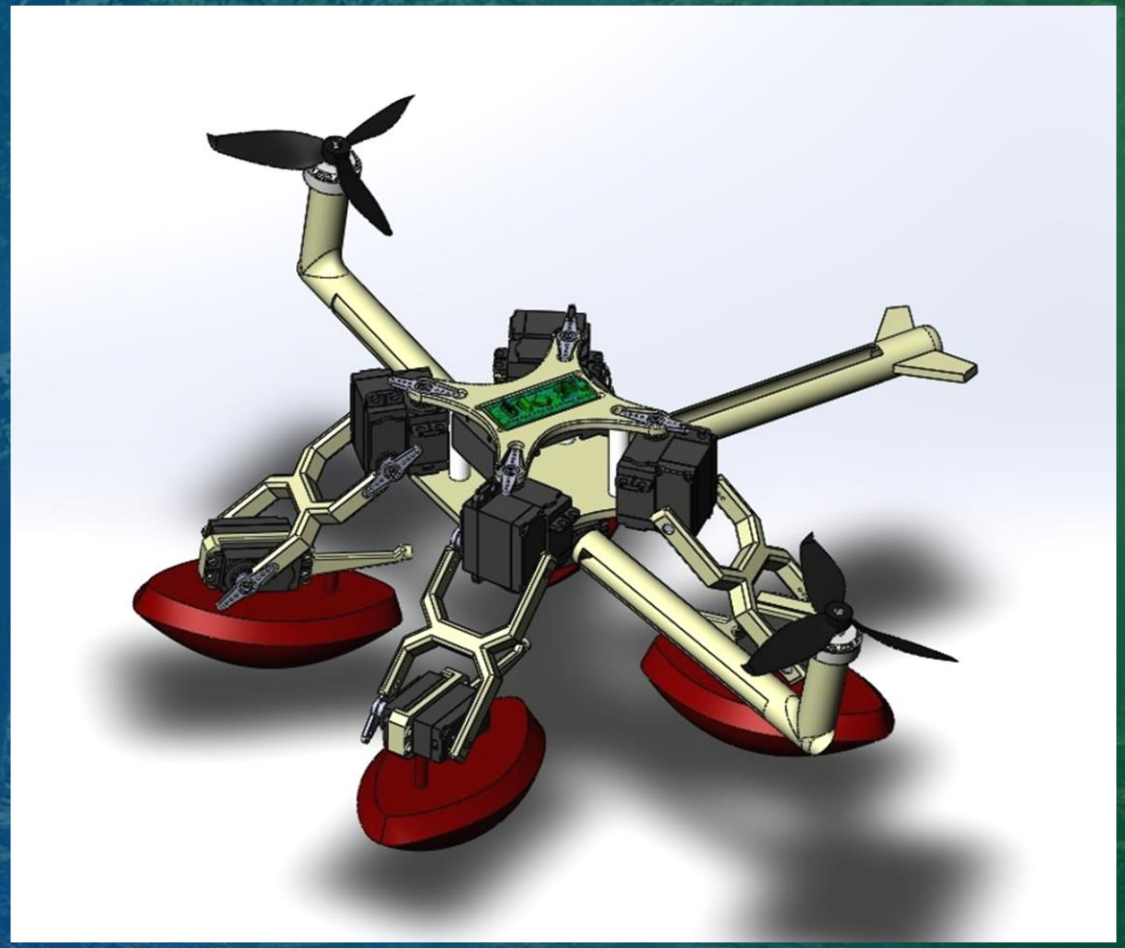
Final Inspiration

- Float With Arms
- Similar Limbs with Spiders

All Terrain Search & Rescue Robot



Water Mode



Breakdown

What makes the AllTerraR tick?

- Robot Body Design
- Actuators
- Navigation System & Controller
- Data Collection
- Data Transmission
- Power System Management

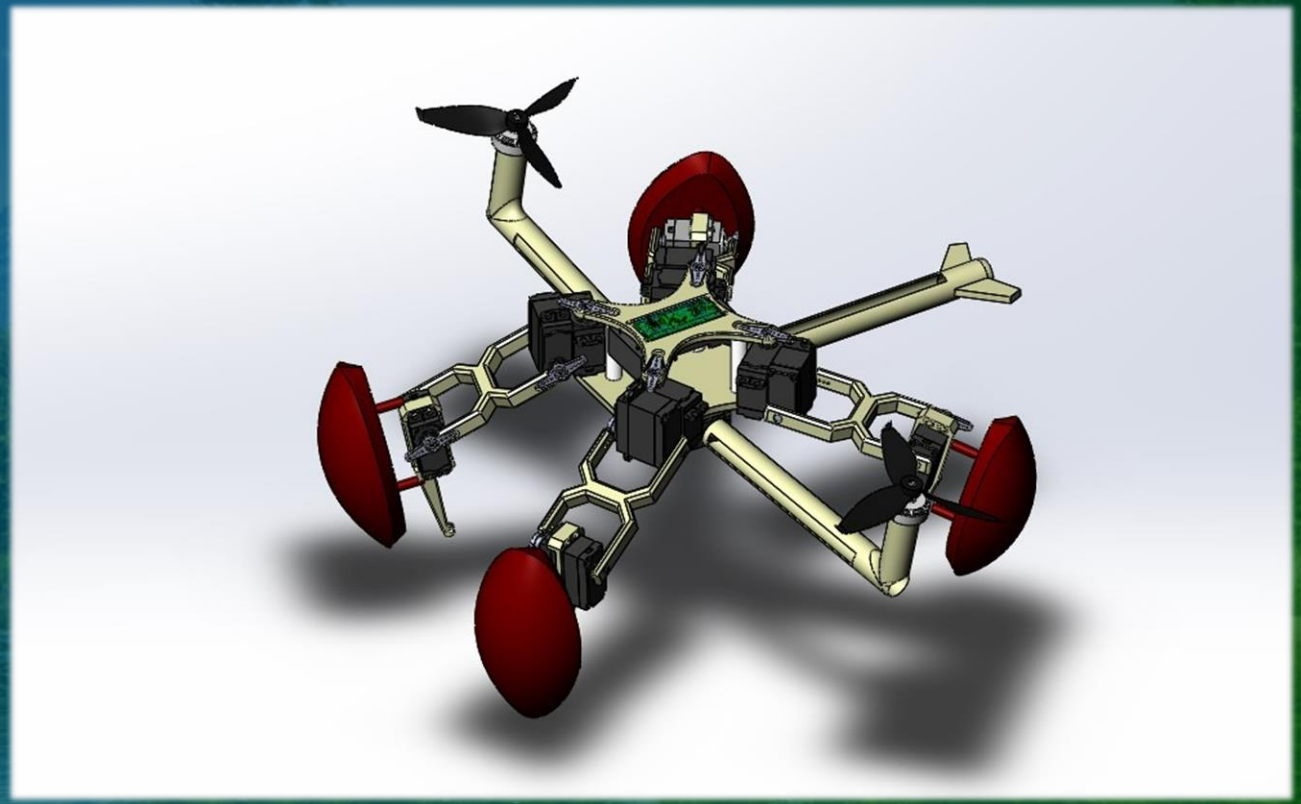
Robot Body Design

Frame & Propeller : Carbon Fibre

- Will not rust
- Lightweight
- Strong

Buoyant: Plastic

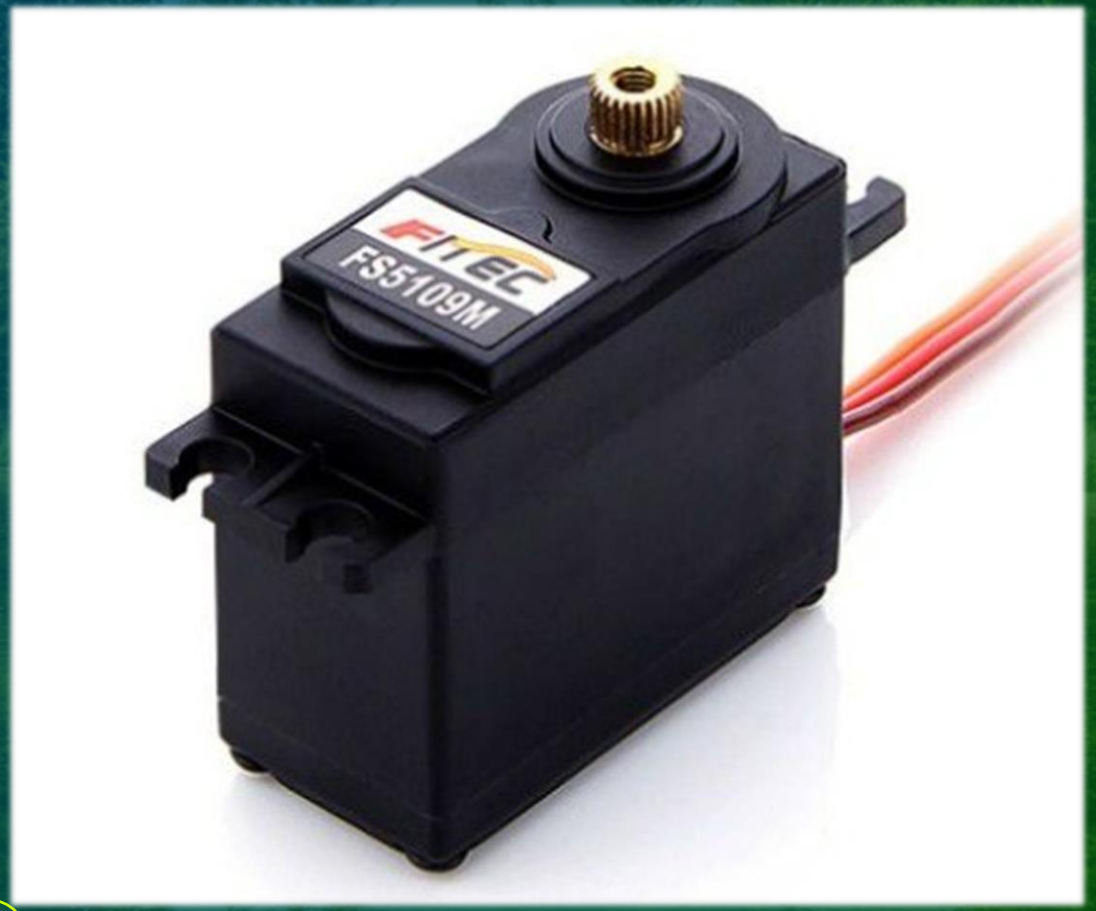
- Lightweight
- Able to deform and support any collision
- Contains Air in order to float



Actuators

FeeTech FS5109M

- Operating Speed: 0.16sec/60degree (6V)
- Stall Torque: 10.2kg.cm/141.9oz.in(6V)
- Operating Voltage: 4.8V~6V
- Control System: Analog
- Direction: CCW
- Operating Angle: 180degree
- Required Pulse: 500us-2500us
- Bearing Type: 2BB
- Gear Type: Metal
- Motor Type: Carbon
- Connector Wire Length: 30 cm



Actuators

T-Motor Antigravity MN5008 Motor

Motor size: ø55.6*32mm

Configuration: 24N28P

Shaft Diameter: 6mm

Lead Cable: 80mm

Idle Current: 0.4A

Max. Power : 720W

Internal Resistance: 720mΩ

Rated Voltage: 6-12V

Peak Current: 15A

Prop Recommendation: P17-18"

Navigation System & Controller

Neo-6M

- Update rate: 1Hz (Default), 5Hz (Max)
- External GPS antenna
- With MicroSD Interface for data storage
- Onboard 3V supercapacitor as a backup battery
- Onboard 3.3v regulator
- 3.3V and 5V logic level compatible
- Power and fix indicator LEDs
- Reset Button
- Weight: 23g, 55g (GPS antenna + cable)
- Baud rate: 9600

Navigation System & Controller

Turnigy MultiStar 30A BLHeli-S Rev16

- Small and lightweight (only 9.1g)
- S code for superior performance
- Smooth and linear control
- Oneshot125 for rapid throttle response
- Compatible with DShot150 and DShot300 firmware
- Regenerative braking
- Active freewheeling
- Beacon functionality
- Stalled motor protection
- Throttle signal loss protection
- Safe power-on (throttle lockout)
- Thermal protection

Navigation System & Controller

Raspberry Pi 4

Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz

1GB, 2GB, 4GB or 8GB LPDDR4-3200 SDRAM (depending on model)

2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE

Gigabit Ethernet

2 USB 3.0 ports; 2 USB 2.0 ports.

Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards)

2 × micro-HDMI ports (up to 4kp60 supported)

2-lane MIPI DSI display port

2-lane MIPI CSI camera port

4-pole stereo audio and composite video port

H.265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode)

OpenGL ES 3.1, Vulkan 1.0

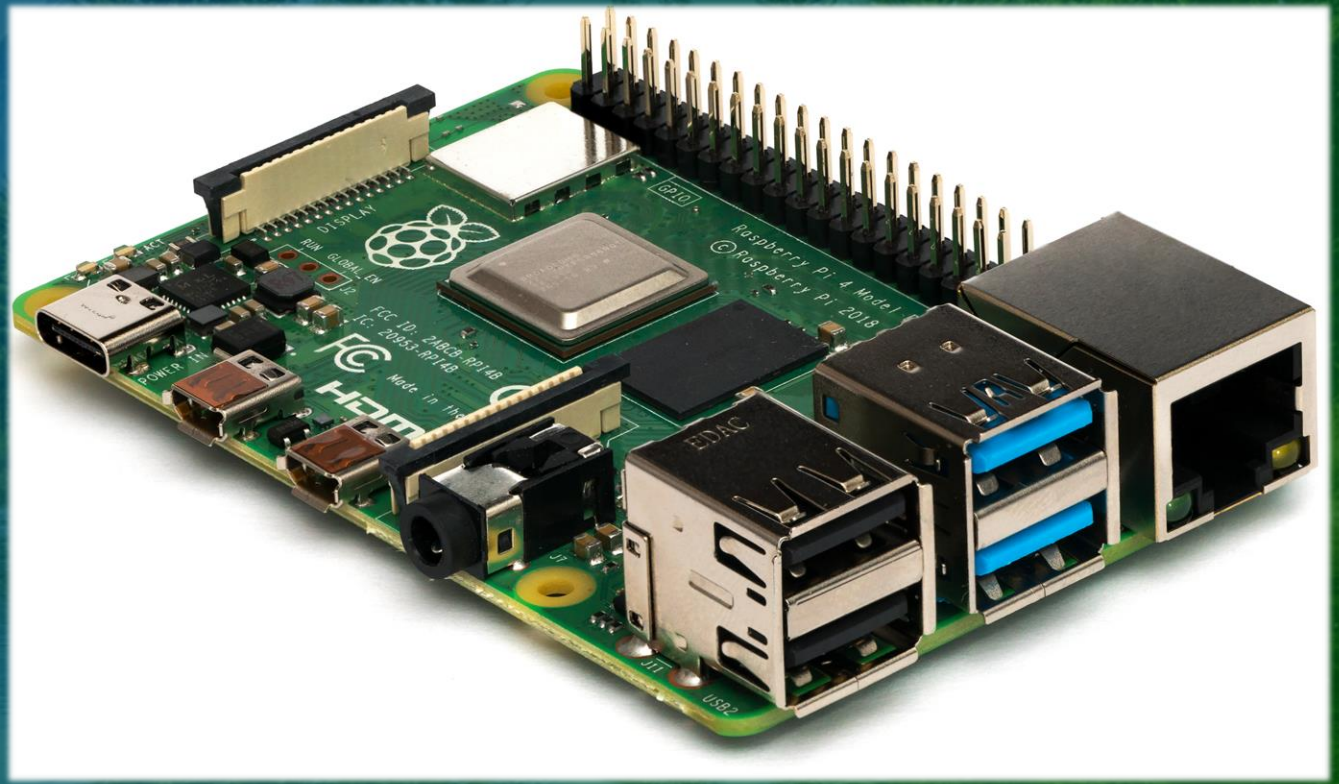
Micro-SD card slot for loading operating system and data storage

5V DC via USB-C connector (minimum 3A*)

5V DC via GPIO header (minimum 3A*)

Power over Ethernet (PoE) enabled (requires separate PoE HAT)

Operating temperature: 0 – 50 degrees C ambient



Data Collection

VN-100

VectorNav proprietary AHRS

VectorNav Processing Engine (VPE)

Real-time gyro bias tracking and compensation

Hard/Soft Iron Compensation

Real-time and delayed heave estimation

Coning and sculling integrals (ΔV's, Δθ's)

Data output format: ASCII (VectorNav), Binary (VectorNav)

World Magnetic & Gravity Reference Models

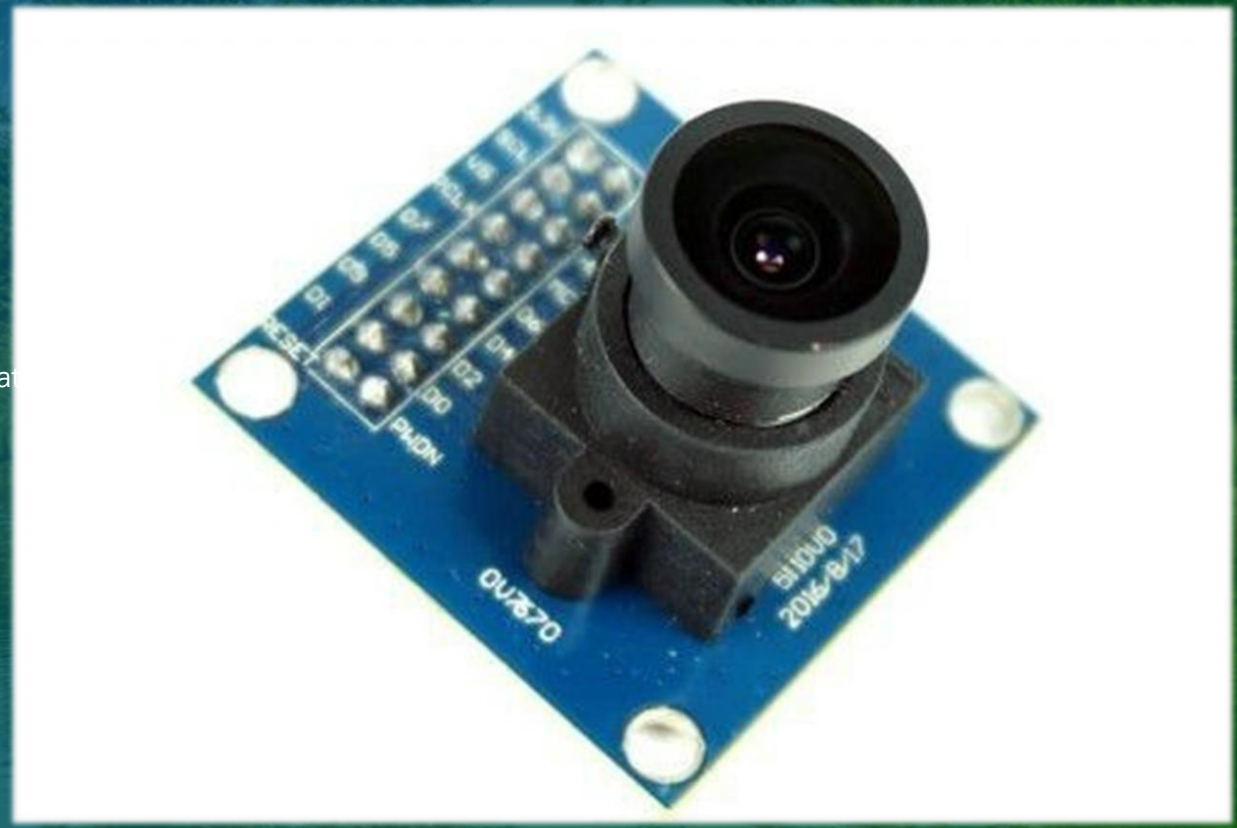
VectorNav Control Center GUI

ITAR-Free

Data Collection

0V7670

- Single power source: 3.3V, onboard regulator
- High sensitivity suitable for illumination applications
- Standard SCCB interface compatible with I2C interface
- Photosensitive array: 640x480 pixel
- IO Voltage: 2.5V to 3.0V (internal LDO for nuclear power 1.8V)
- Power operation: 60mW/15fpsVGAYUV
- Output Formats: YUV/YCbCr4: 2:2 RGB565/555/444 GRB4: 2:2 Raw RGB Dat
- Optical size: 1/6 "
- FOV: 25 °
- Maximum Zhen rate: 30fps VGA
- Sensitivity: 1.3V / (Lux-sec)
- SNR: 46 dB
- Dynamic range: 52 dB
- View Mode: Progressive
- Electronic Exposure: 1 line to 510 line
- Pixel Size: 3.6μm x 3.6μ



Data Transmission

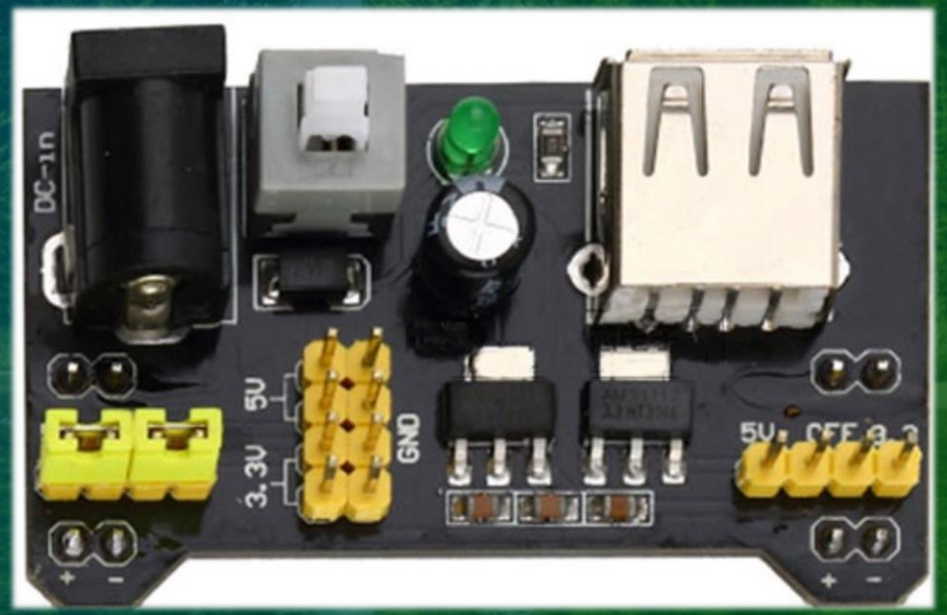
Mayatech RFD900X 915Mhz 3DR Radio Telemetry Modem Module

- Communication rate: 4,8,16,19,24,32,48,64,96,128,192 and 250 kbps.
- Transmitting power: 0 to 30 dBm, 1 dBm stepping adjustable.
- Power supply voltage rated 5V minimum 4V maximum 5.5V;
- Emission current: 1A (maximum power mode);
- Acceptance current: 60 mA;
- Working temperature: – 40 to + 85 degrees Celsius;
- Dimensions: 32.5 mm * 53 mm * 9.5 mm
- Weight: 23g

Power System Management

MB-102 Breadboard Power Supply Module

- Input voltage: DC 6.5-12V or powered by USB
- Output voltage: 5V, 3.3V
- Maximum Output Current: 700mA



Power System Management

RADIOMASTER 21700

- Item: 21700 5000mAh Battery
- Capacity: 5000mAh
- Watt Hours: 37wh
- Voltage: 7.4V
- Cells: 2 x 21700 Li-ion 3.7V 18.5Wh
- Connector: JST-XH and XT30
- Charge current: Max 2amp

Total Power Draw

T-Motor Antigravity MN5008 Motor: 720Wh * 2 = 1440Wh

Turnigy MultiStar 30A BLHeli-S Rev16 V3: 30Ax14.8= 444Wh

Vn-100: 220 mW ~ 0.22Wh

Mayatech RFD900X : 1Ax5.5V =5.5Wh

OV7670 VGA Camera Module: 60mW/15fps =4mWh

Servo: 6Wh * 14 = 84Wh

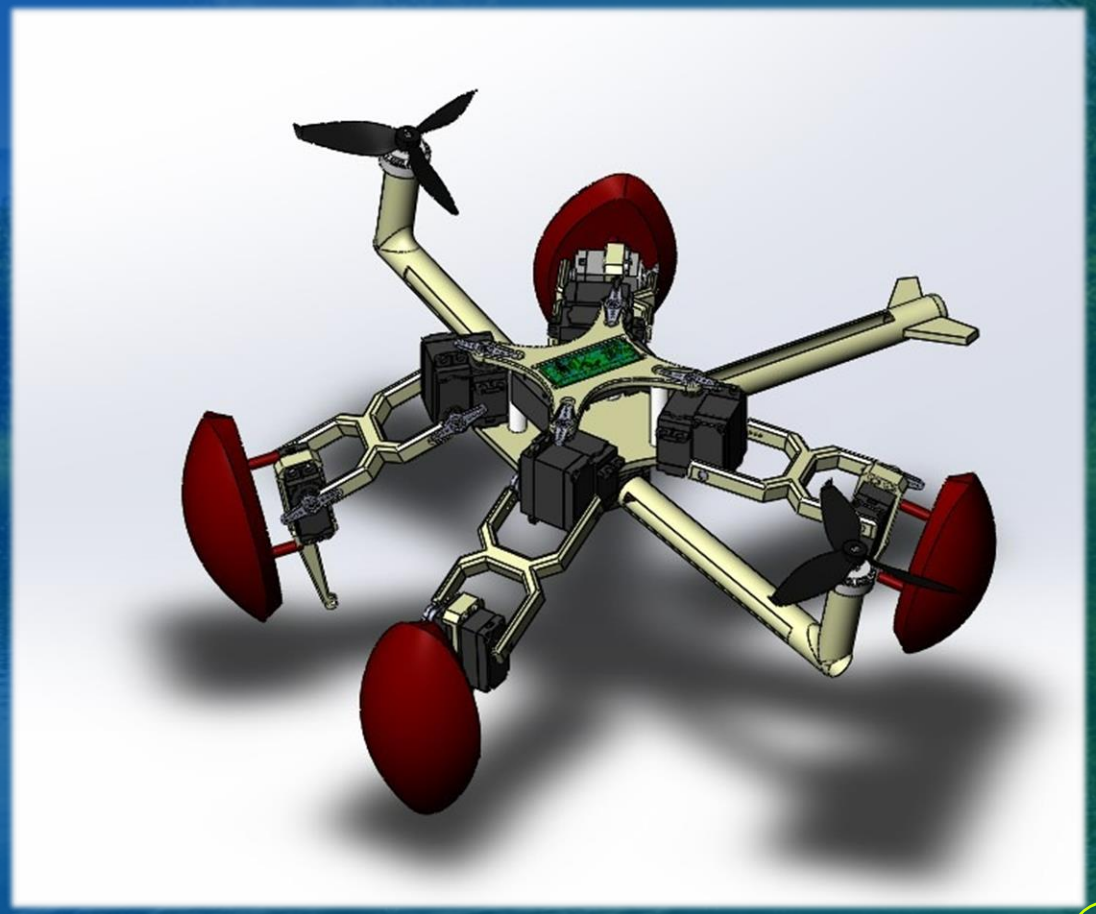
Total power consumption:
1973.76 ~ 2000Wh

Total Runtime:

5000mAh / 2000Wh

=2.5hrs

Safety of the Robot



- Buoyant pads attached to the legs of the robot help protect against impact
- Components are contained and waterproofed in an acrylic shell to avoid water damage
- Robot is built with a master switch that cuts power to all components in case of emergency
- Parts can be individually replaced if a component or part of the body is damaged

THANK YOU!

Feel free to ask any questions!