Abstracted System

This write-up describes the software architecture of the firmware run on HIVE vehicles, which is composed of three subsystems: the High Level Guidance Navigation and Control (HLGNC) subsystem, the core subsystem, and the driver subsystem.

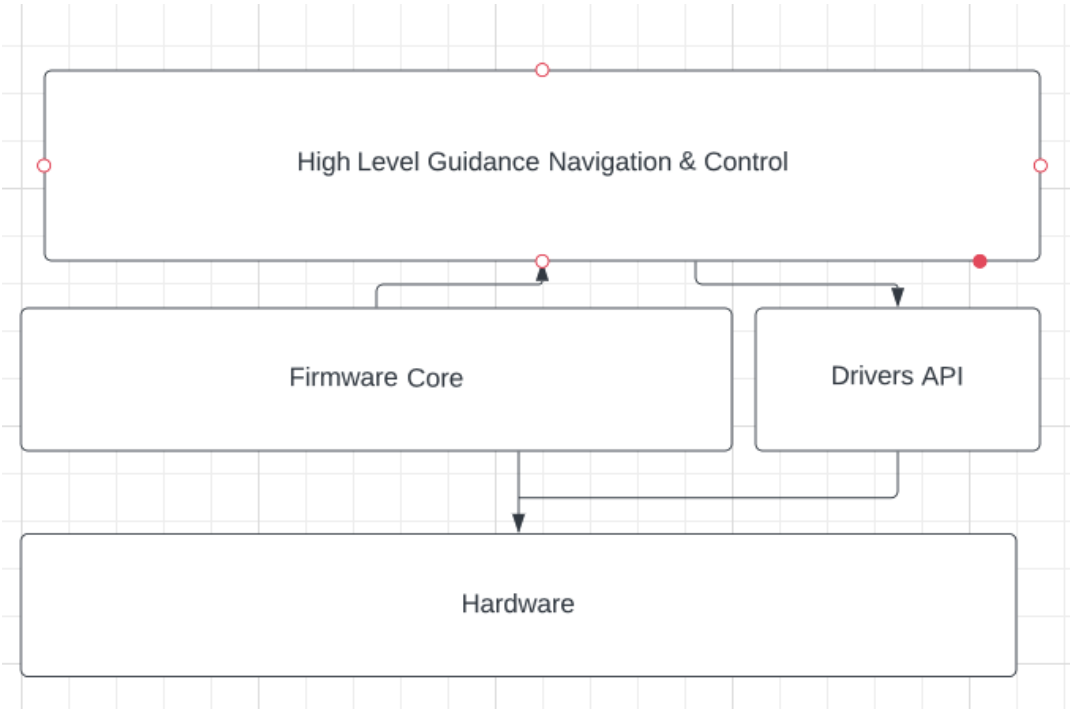


Fig 1.

The HLGNC subsystem is responsible for generating flight paths and controlling the vehicle's position. It does this by using a combination of sensors, including GPS, to create a map of the environment and track the vehicle's position within that map. The HLGNC subsystem also uses algorithms to generate flight paths that avoid obstacles and take into account the vehicle's constraints, such as its speed and range.

The core subsystem is responsible for managing the vehicle's hardware and software. It does this by initializing the drivers, the Wi-Fi / http server, and other miscellaneous systems. The core subsystem also provides a communication interface between the HLGNC subsystem and the driver subsystem. It is run using a state machine with three distinct states. standby, bypass and armed. These three states are triggered by a user input from the web server hosted by the flight computer. The user chooses which state the controller will be in and the vehicle sets its current state. Upon boot the firmware core initializes the drivers, the Wi-Fi / http server, and other miscellaneous systems.

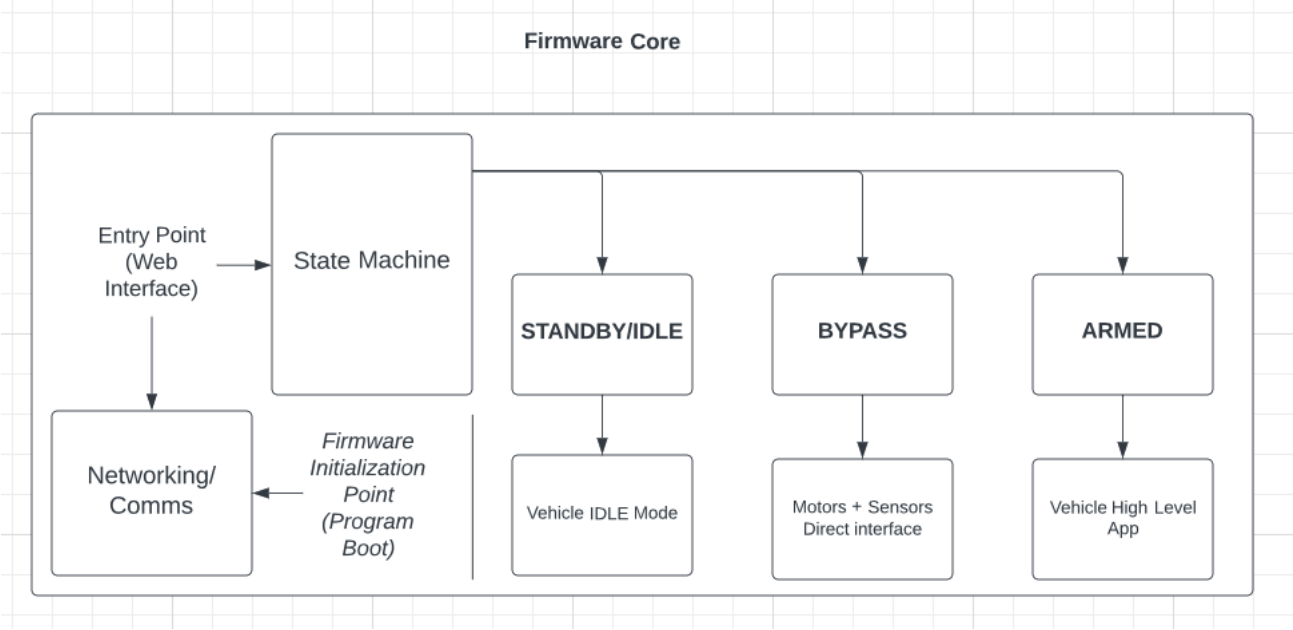


Fig 2.

The driver subsystem is responsible for interfacing all the sensors on board, the wing motors, the controller fan and the main throttle motor. The software architecture of the vehicle is designed to be modular and scalable. This allows for easy addition of new

features and components as the technology evolves. The architecture is also designed to be robust and reliable, with multiple layers of redundancy to ensure safe operation.

Program Temporary Access Memory

Program Temporary Access Memory (PTAM) is a shared memory API that was written so different modules can retrieve updated data without having to call another module and wait for a response. When a module is run and data is computed it is able to store the specific data into a PTAM register with an ID. Another module can then retrieve data stored in this PTAM register by referencing its unique ID.

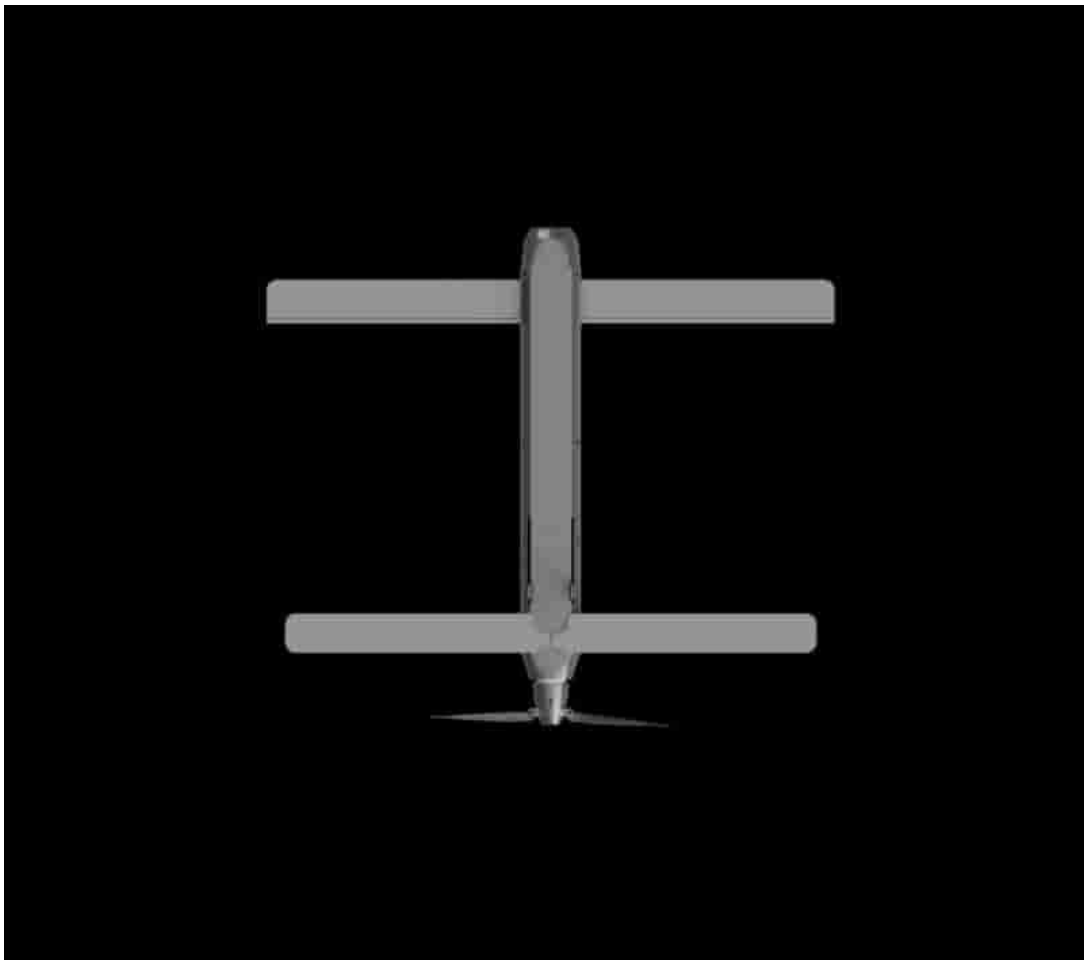
PTAM works by creating a shared memory space that is accessible to all of the modules. When a module needs to store data, it can write the data to the shared memory space. Other modules can then read the data from the shared memory space by referencing the unique ID of the data.

PTAM is a powerful tool that can be used to improve the performance and efficiency of multi-threaded applications. Some of the benefits of using PTAM include:

- Increased performance: PTAM can improve performance by reducing the amount of time and resources that are needed to communicate between modules.
- Improved efficiency: PTAM can improve efficiency by allowing modules to access the data they need without having to wait for another module to respond.

- Reduced complexity: PTAM can reduce the complexity of multi-threaded applications by eliminating the need for modules to communicate directly with each other.
- Increased scalability: PTAM can be scaled to support large numbers of modules and data items.

Vehicle Systems



Sensors & Peripherals on board:

- BNO055 Inertial Measurement Unit

- BMP280 Barometer
- ATGM336H GPS Module
- SD Card Module

The vehicle has 4 servo motors which sweep the wings back and forward. By adjusting the sweep on each wing we can affect the rotational torque on the vehicle causing a movement in roll, pitch and yaw. Main throttle is a brushless DC motor.

Web Interface / Operator Entry Point

Upon boot, the vehicle initializes its WiFi and goes into AP mode. It now broadcasts as a wireless access point for any WiFi-enabled device to connect. The firmware has been hard restricted to one client at any given moment to eliminate the possibility of multiple devices accessing the vehicle at once. This is done to prevent unauthorized access to the vehicle's systems and data.

The web client is a web-based interface that allows users to easily set up and configure the vehicle. The web client can be accessed from any device that is connected to the vehicle's WiFi network. The web client provides a variety of features, including:

- Device configuration: The web client allows users to configure the vehicle's WiFi settings, network settings, and other device settings.

- Vehicle status: The web client provides users with information about the vehicle's status, such as its battery level, GPS location, and other vehicle data.
- Vehicle diagnostics: The web client allows users to run diagnostics on the vehicle and view the results.
- Software updates: The web client allows users to download and install software updates for the vehicle.

The web client is a valuable tool for users who want to easily set up and configure their vehicle. It is also a valuable tool for troubleshooting problems with the vehicle.

- The WiFi network that the vehicle creates is typically called "HIVE2"
- The password for the WiFi network is typically is planned to be the serial number of the vehicle.
- The web client can be accessed by opening a web browser and entering the IP address of the vehicle in the address bar.
- The IP address of the vehicle can be found in the vehicle's documentation or by running a network scan on the WiFi network.
- The web client is typically accessible only when the vehicle is in AP mode.

The web client has to be accessible and fully functional in areas with no internet connection to configure the vehicle so no external CDNs or libraries can be used when programming the web client. It also has to be as lightweight as possible as it is stored in vehicle flash memory.

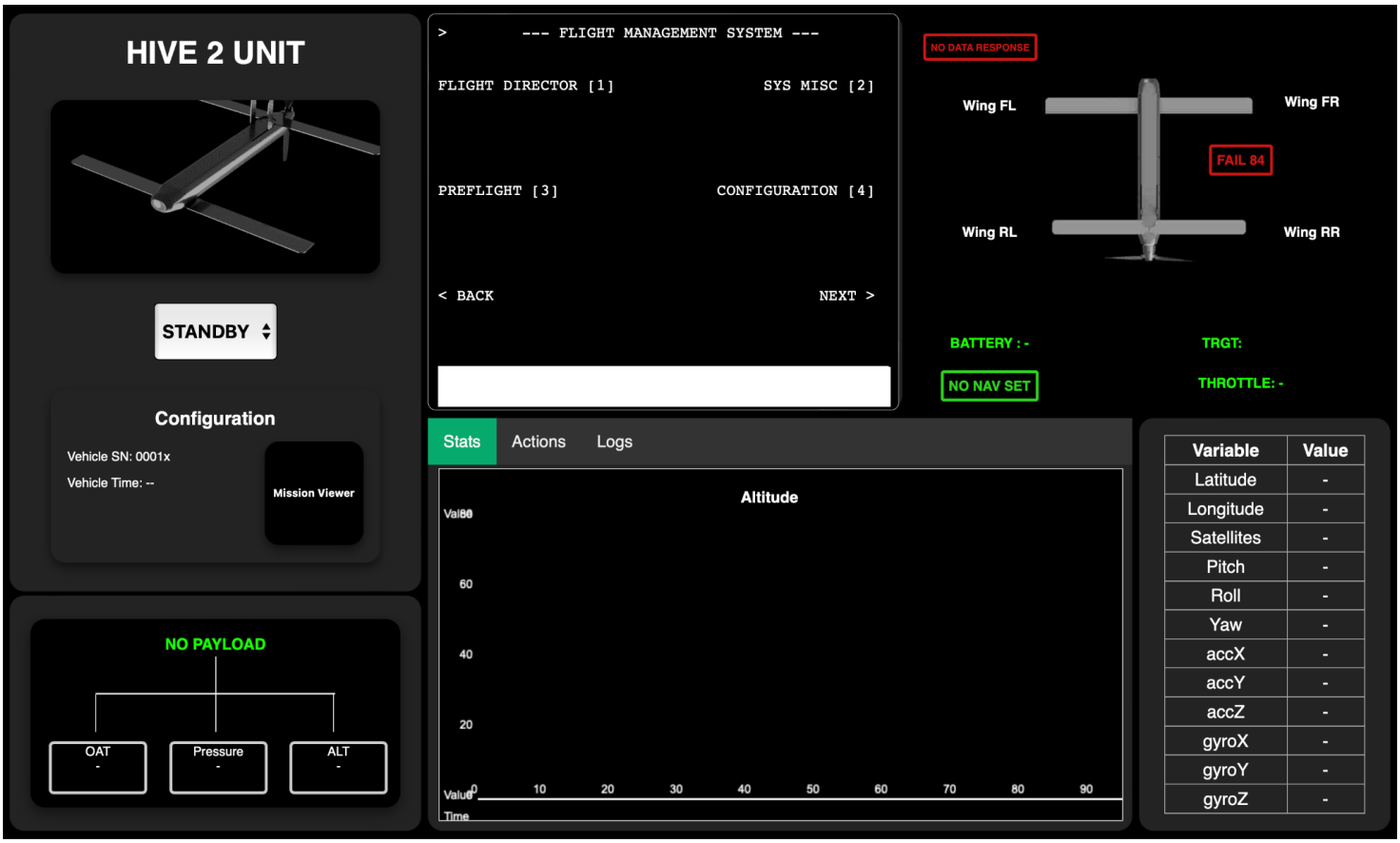

HIVE 2 UNIT
STANDBY
Configuration
Vehicle SN: 0001x
Vehicle Time: --
Mission Viewer
NO PAYLOAD
OAT
-
Pressure
-
ALT
-
> --- FLIGHT MANAGEMENT SYSTEM ---
FLIGHT DIRECTOR [1]
SYS MISC [2]
PREFLIGHT [3]
CONFIGURATION [4]
< BACK
NEXT >
NO DATA RESPONSE
Wing FL
Wing FR
FAIL 84
Wing RL
Wing RR
BATTERY : -
TRGT:
NO NAV SET
THROTTLE: -
Stats
Actions
Logs
Altitude
Value
Time
0
10
20
30
40
50
60
70
80
90
20
40
60
Variable
Value
Latitude
-
Longitude
-
Satellites
-
Pitch
-
Roll
-
Yaw
-
accX
-
accY
-
accZ
-
gyroX
-
gyroY
-
gyroZ
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Fig 3