Preliminary Design Review

The Flying Mustangs

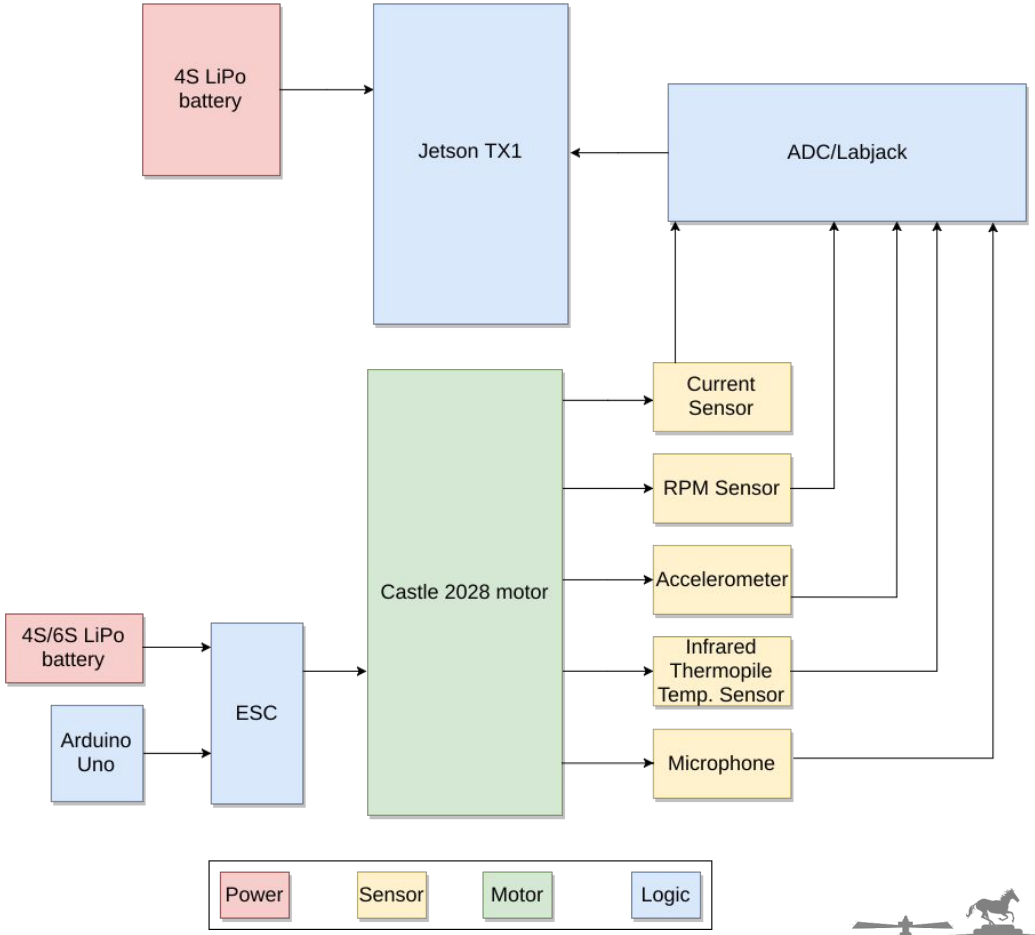
Needs

- Sensors
  - Accelerometer, RPM sensor, current sensor, temperature sensor, microphone
  - (Optional) Receiver Voltage sensor
- Lab Jack
- LiPo batteries
- Electronic speed controller
- Propeller
- ADC(s)

Will obtain from ES Aero

Specifications

- Software
  - Linux Environment (Jetson)
  - Keras (Neural Net)
  - TensorFlow (Neural Net)
  - LJstreamUD (Labjack)
  - Arduino IDE
- Hardware
  - Sensor Suite
  - ADC (Labjack used for testing)
  - Jetson TX1
  - 4S battery/19V power supply
  - ESC
  - Arduino



Constraints

- Propeller must be at least 16 inches in order to provide appropriate loading on shaft
- System must be able to run for multiple hours without interference in order to collect all necessary data
- ADC must have an accuracy of at least 16 bits in order to ensure precise data
- System must eventually be able to run with a gas engine
- A battery with a voltage in the range of 4S to 8S must be provided to the system
- Current sensor must have a range of at least 35 A
- Embedded system must be capable of implementing machine learning algorithm

Deliverables

- Weekly progress reports regarding UAS System
- System that detects an error with electric motor
- System that displays specific error when it occurs
- System that detects and can display specific errors, while incorporating gas engine

Possible Design Directions

ADC count

- One ADC per motor
- One ADC per system (less than five motors)

Battery Setup

- Power Jetson and motor using same battery
- Power Jetson using its own battery

Sensor Suite possibilities

- Accelerometer, RPM sensor, current sensor, thermal sensor, and microphone
- All of the above with Rx pickup

Pros and Cons (ADC Motor)

One ADC per motor

Pros	Cons
Less complicated	More hardware
Only have to worry about setting up one channel per sensor per motor	Excess channels not utilized
Will likely need more ADC’s	

One ADC per system

Pros	Cons
	More complicated
Maximum use of ADC	Harder to implement since using multiple channels
Less expensive	Will likely need more ADC’s

Pros and Cons (Battery Setup)

Power Jetson and motors using same battery

Pros	Cons
Less hardware	May have to buy a larger battery
Less expensive	Smaller battery life for system

Power Jetson using its own battery

Pros	Cons
Smaller Batteries	More hardware
Longer system battery left	More expensive
Less complicated	

Pros and Cons (Sensor Suite Possibilities)

Accelerometer, RPM sensor, current sensor, and thermal sensor, microphone

Pros	Cons
Less hardware	Not as accurate
Less expensive	Less testing sensors
Less complicated	
Easier to implement	

All including Rx pickup

Pros	Cons
More accurate	More complicated
More testing implemented	More hardware
	More expensive
	Hard to implement Rx pickup

Cost Estimates

Spec. Number	Parameter Description	Cost Per Item	Quantity	Price
1	Castle 2028 Extreme 800KV Brushless Motor	$226.06	1.00	$226.06
2	Honda Horizontal OHC Engine — 25cc, GX Series	$219.99	1.00	$219.99
3	Current Sensor (Digikey 398-1023-ND)	$19.73	1.00	$19.73
4	ADXL345 - Triple-Axis Accelerometer	$17.50	1.00	$17.50
5	Brushless Motor RPM Sensor V2	$14.99	1.00	$14.99
	Microphone Sensor (Digikey 490-7706-ND)	$6.80	1.00	$6.80
6	Contact-less Infrared Thermopile Sensor Breakout	$12.50	1.00	$12.50
9	NVIDIA Jetson TX1 Development Kit	$559.99	1.00	$559.99
10	LabJack U6	$319.00	1.00	$319.00
11	Castle Ice Lite 75A Electronic Speed Controllers	$86.99	1.00	$86.99
12	Tattu 14.8V 5200mAh 4s 15C~30C Lipo Battery Pack	$23.59	1.00	$23.59
13	Arduino Uno	$25.95	1.00	$25.95
14	Quanum T-Style Prop 20x5.5	$49.94	1.00	$49.94
	Total			**$1,583.03**

Potential Issues

- Installing Keras on Jetson TX1
- Data not sensitive enough, causing system to not distinguish errors
- Miscategorization of a fault due to similar data from two separate issues
- Mismatched sampling rates causing complications with the neural net
- Introducing proper faults into the system
- Battery running out of power during testing
- Presently chosen current sensor has a 35A limit while ESC limit is 75A

Project Timeline

UAS Hybrid Milestones

Select a period to highlight at right. A legend describing the charting follows.

Period Highlight: 1

Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Deliver Requirements	2	2	2	2	100%
Deliver Project Charter	3	2	3	2	100%
Final Parts List Delivered	1	5	1	5	100%
Present Design Review	4	1	4	0	0%
Create a Neural Network	5	4	5	4	0%
Functional Prototype for Electric Motor	1	10	1	4	5%
Functional Hybrid Prototype (Electric and Gas)	1	25	4	6	2%