Your Fire Nation

ArGus

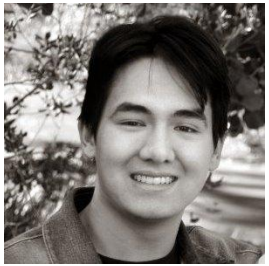
Introduction | Who We Are

Eric Swenson

Team Lead

Andrew Tran

Team Scribe



Alex Thielk

Team *Fire*$_{base}$*bender*

Ángel Ortega

Team ☕ Expert

Gustavo Cornejo

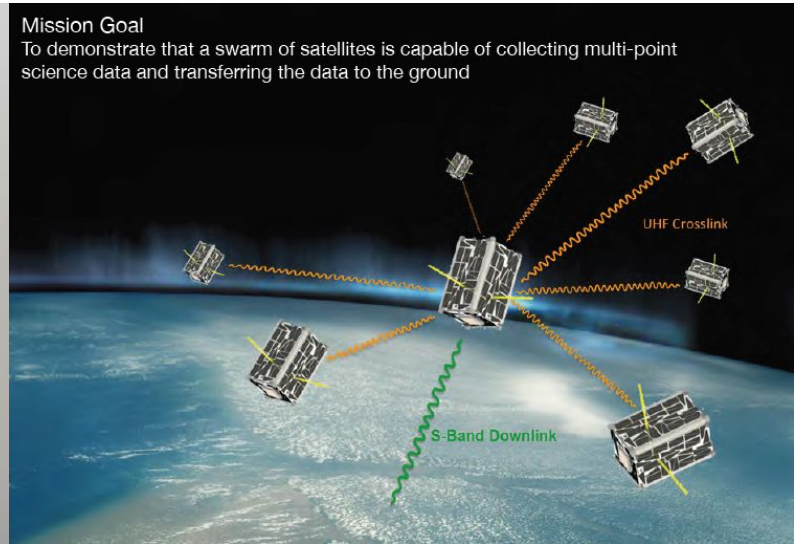
Team Guüs

ArGus:

- ♙ **Aerocube-WebApp** (UI)
- ♖ **Aerocube** (Infrastructure)
- ♘ **Aerocube-ImP** (Image Processing)
- ♕ **Aerocube-MaL** (Machine Learning)

Your Fire Nation

CubeSat Swarms for Attitude Control



Problem

- High maintenance
  - Astronauts are required to service satellites
  - Manned-missions are not reachable from a shuttle for monitoring
  - Communication Signals from Earth are unreliable
- Deployed satellites require monitoring
- Tradeoffs: Power dissipation vs. Performance
- Processing Power

Motivation

- **Satellites Are Expensive**
  - The CubeSat is a low-cost solution for space missions
- **Deep Neural Networks and CUDA**
  - Algorithms can now run on a low-cost 50x87mm NVIDIA embedded computer
  - Allows for GPU-accelerated parallel processing
  - High-performance, low-power tradeoff
- **Computer Vision**
  - Computer Vision for estimating pose and identifying entities
  - Computational power with GPUs, parallel programming, and ML models

Technologies

Web Application

- **React.js**
  Ecosystem & Views
- **Redux**
  Async Event Lifecycle
- **Reselect**
  Efficient Data Hooks
- **Immutable.js**
  Application State
- **Firebase**
  DB & Bucket Storage
- **Webpack**
  Bundling & Building
- **Enzyme, Karma, Mocha, & Chai**
  Testing

Infrastructure

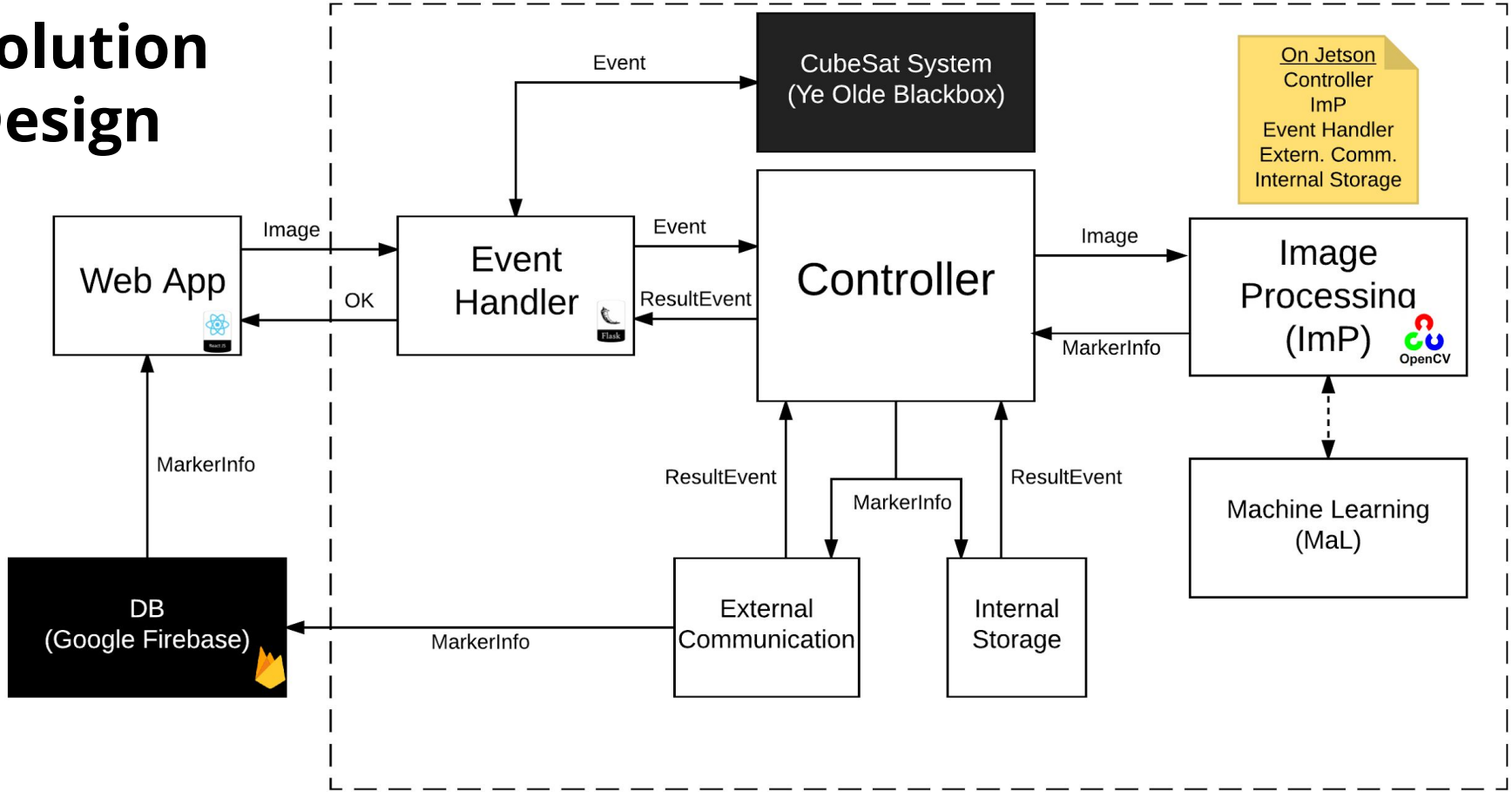
- **Flask**
  Event Source
- **Events and Signals**
  Custom Event System
- **TCP**
  Communication
- **Controller**
  Center of the world
- **NVIDIA Jetson TX1**
  High-Performance "CubeSat"

  Satellites are Expensive

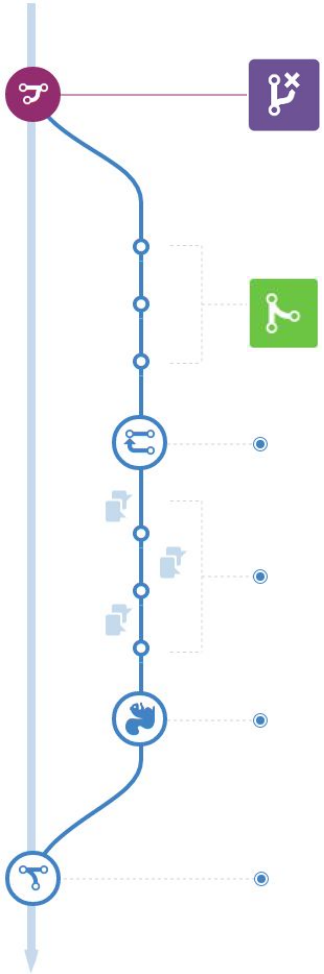
Image Processing

- **OpenCV**
  Image Manipulation
- **Aruco**
  Fiducial Marker Creation, Detection
- **NVIDIA CUDA**
  GPU-Accelerated Image Processing

Solution Design



Roadmap



Current Status

Merged

- Receive image
- Identify fiducial marker(s)
- Store results in database

Future steps

Open

- Using pose from fiducial markers find pose of AeroCubes
- Complete Dashboard UI
- CUDA-accelerated programming
- Garbage collection of similar images and redundant data
- Making software architecture independent for future space deployment missions
- Feedback to the camera

Merge pull request

Prototype Demo

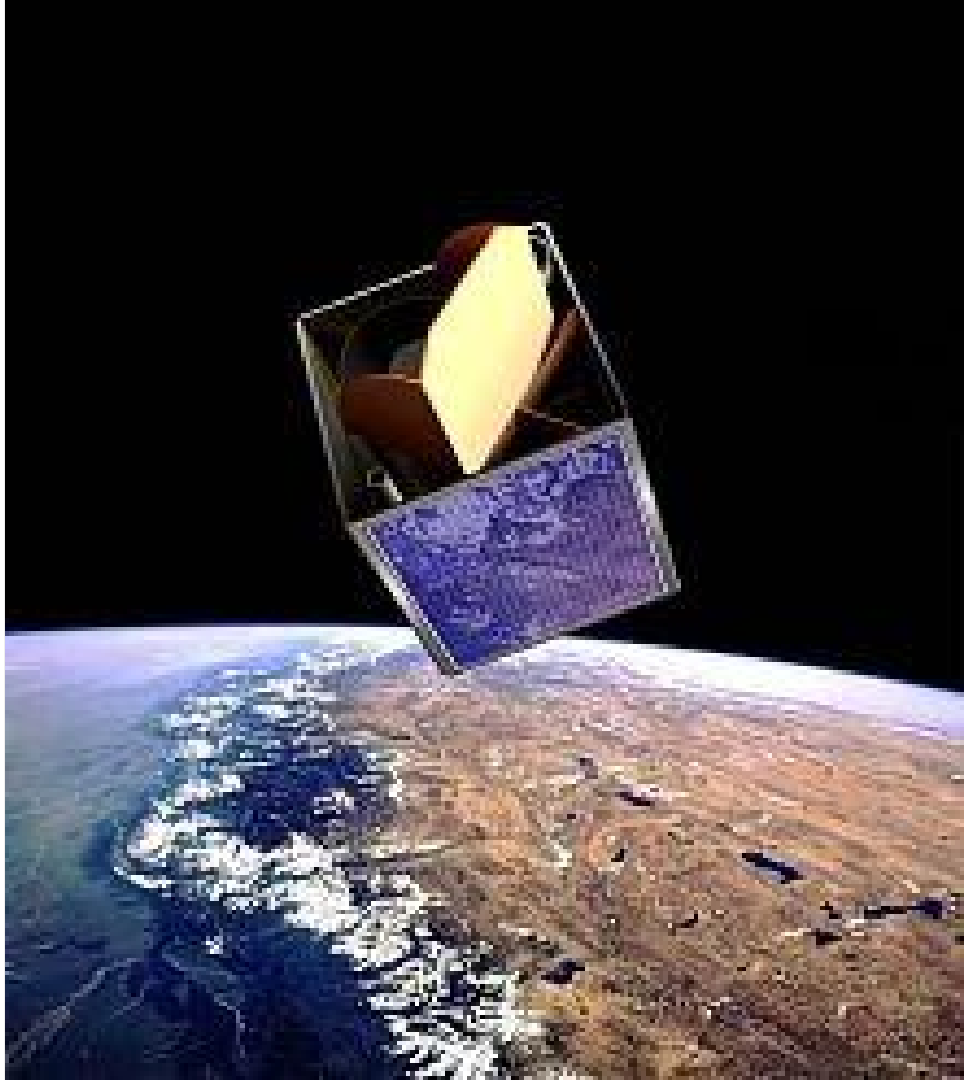
Main Use Case:

1. Send image
2. Process image
3. Receive ID’s in firebase

Questions?

Satellite Attitude Control & Image Acquisition

On June 30 2003, a CubeSat space deployment mission (AAU CubeSat), for the purpose of creating an attitude control system and acquiring images of the Earth, was launched by the Aalborg University in Denmark.[1]



[1] Alminde, Lars, et al. "Educational value and lessons learned from the AAU-CubeSat project." In *Recent Advances in Space Technologies, 2003.*