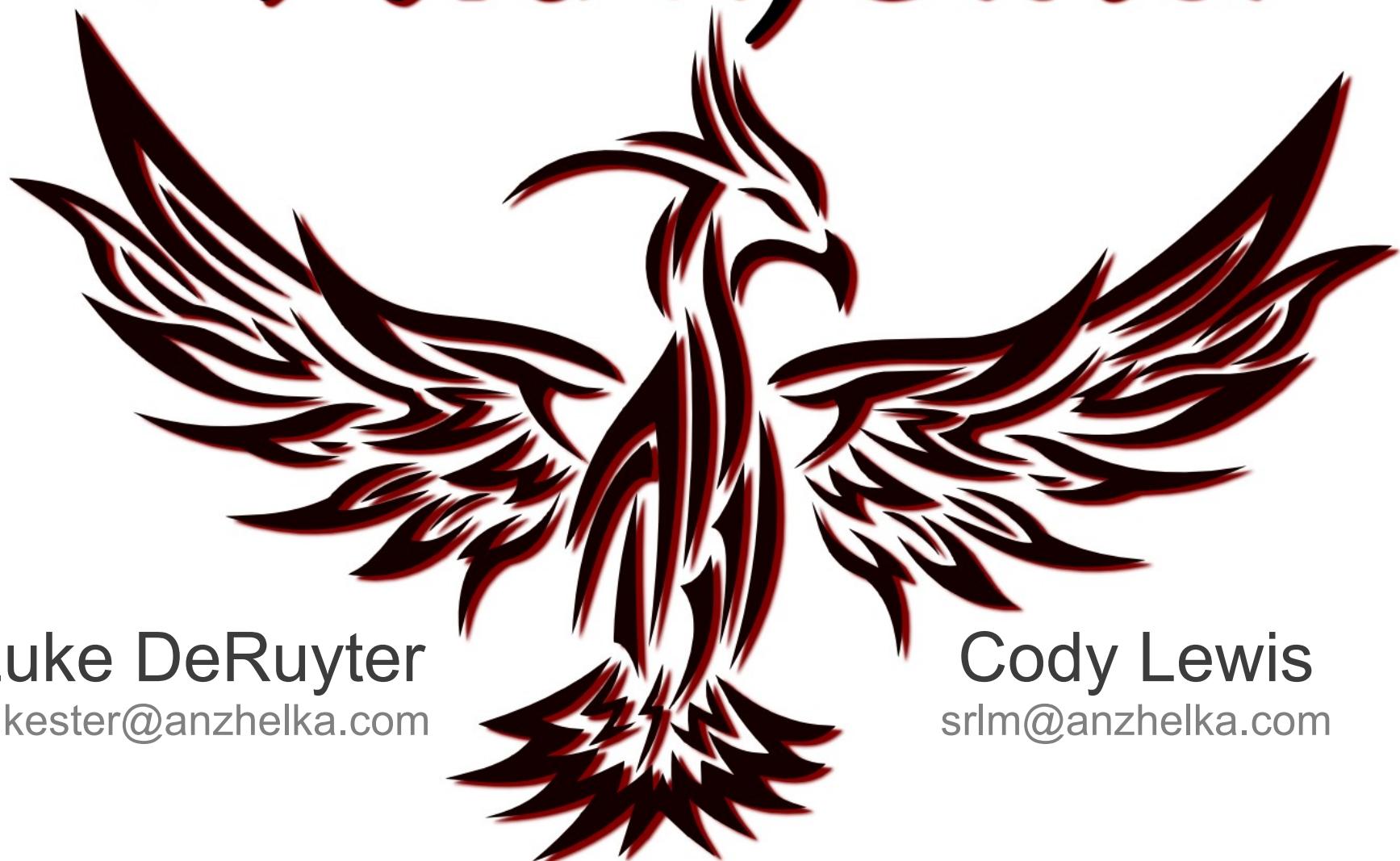


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Luke DeRuyter
ilukester@anzhelka.com

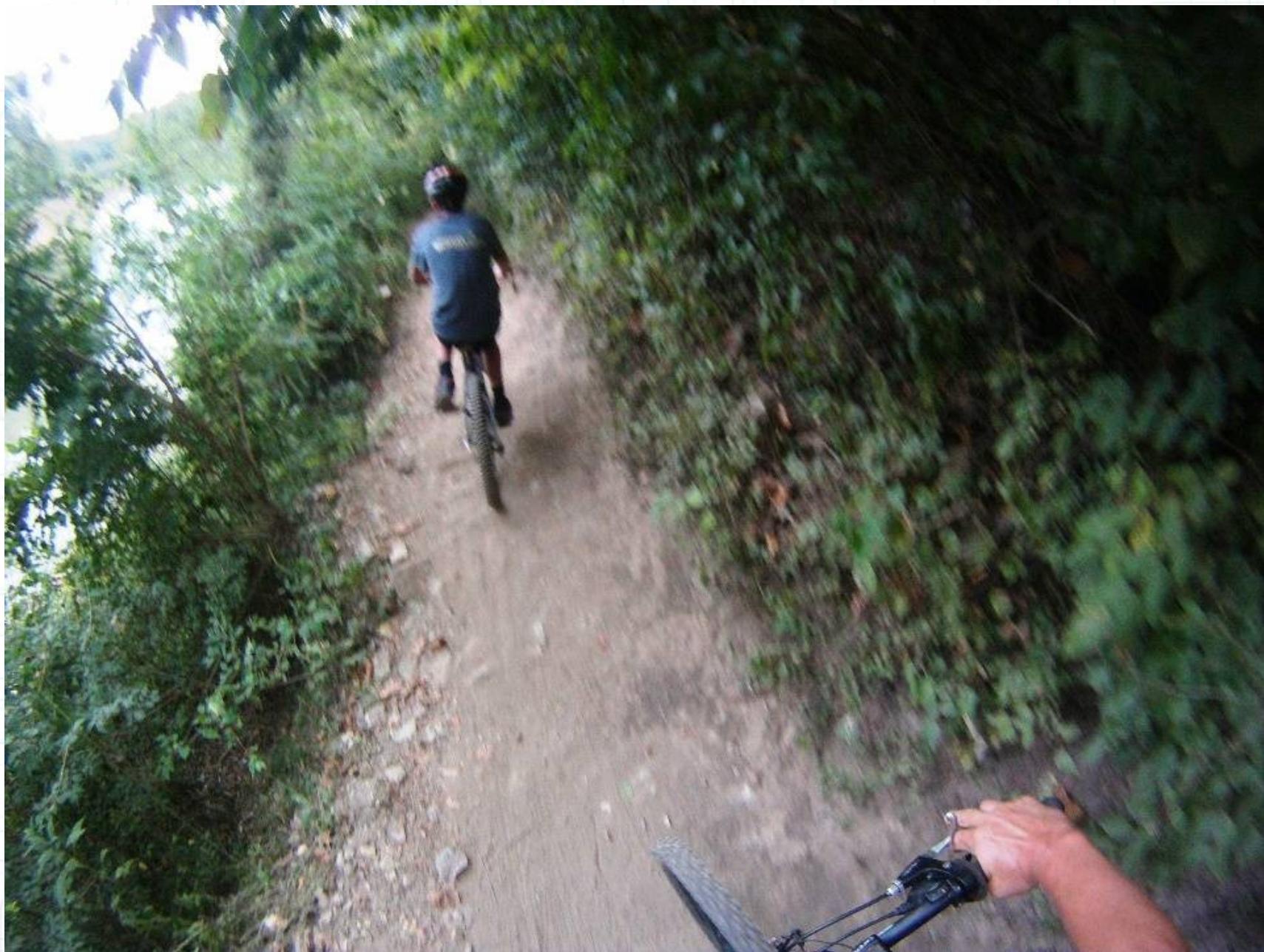
Cody Lewis
srlm@anzhelka.com

The Problem:

- It's difficult to film extreme sports
 - Mountain biking
 - Snowboarding/skiing
 - Cross country running
 - White water rafting



Helmet mounted GoPro Camera



Poor focus, blurriness, and distortion

Traditional Options

- Helmet cameras get boring fast
- Cameramen along the path are no good
- A vehicle might work...

But is expensive





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Quadrotor Advantages

- A quadrotor can
 - Fly closer to the athlete
 - Operate at lower costs
 - Be more portable and available
 - Carry large payloads

Goal

Create a fully programmable
aerial quadrotor that is
**autonomous, stable, and
controllable**

Ancillary Goals

- Create stable quadrotor platform
- Use Parallax P8X32A for low level control
- Be completely open source, from hardware to software
- Have extensive and up to date documentation on all aspects

Open Online Repository

Screenshot of a web browser displaying the Google Code repository for the "anzhelka" project.

The URL in the address bar is code.google.com/p/anzhelka/source/list.

The page title is "Changes - anzhelka - Propeller based Quadrotor".

The user is logged in as [srlm@anzhelka.com](#).

The main navigation menu includes Project Home, Downloads, Wiki, Issues, Source (selected), and Administer.

Below the menu, there are links for Repository (default), Checkout, Browse, Changes (selected), Clones, and a search bar for "Search Trunk". There is also a "Request code review" button.

The main content area shows a table of committed changes:

Rev	Scores	Commit log message	Date	Author
c7ef18efd743		Created introduction presentation, added system model diagram	Yesterday (18 hours ago)	srlm <srlm@anzhelka....
e22c6f86a357		Added REV-A and the current QuadPower Boards, removed old files	Mar 9 (5 days ago)	ilukester <ilukester@a...
8a8afa006f79		Added some documentation, first revision of mathematics report, etc.	Mar 8 (6 days ago)	srlm <srlm@anzhelka....
61e40c43a192		Added a compile/download/terminal script for MPU6050	Feb 1, 2012	srlm <srlm@anzhelka....
10de50a9da6c		Added some of Luke's datasheets	Jan 31, 2012	srlm <srlm@anzhelka....
a8a75e26604b		Setup basic directory structure, added support files (datasheets, compil...	Jan 30, 2012	srlm <srlm@anzhelka....
ce148acd868b		Almost all parts on single layer, currently will auto route without proble...	Jan 30, 2012	unknown <ilukester@a...
ad8db7ea9a51		File cleanup	Jan 30, 2012	unknown <ilukester@a...
59764ad0146b		added label to FullDuplexSerialPlus (but this is really testing the branch...	Jan 25, 2012	srlm <srlm@anzhelka....
ddc9b549a785		Initial Commit	Jan 25, 2012	srlm <srlm@anzhelka....

Text at the bottom right: Yesterday - Jan 25



Open Hardware



Parallax Elev-8

Open Costs

Supplier	Name	Unit	Qty	Total
Parallax	Altimeter	\$29.99	1	\$29.99
Parallax	Protoboard USB	\$29.99	1	\$29.99
Parallax	Propeller Chip QFP	\$7.99	1	\$7.99
Parallax	64KB EEPROM	\$1.99	1	\$1.99
Parallax	5 MHz Crystal	\$1.10	1	\$1.10
Sparkfun	Radio Modem UM96	\$44.95	2	\$89.90
Hobby King	450 Outrunner Motor - Trinigy	\$14.04	4	\$56.16
Hobby King	30A ESC	\$5.99	4	\$23.96
Hobby King	3S 30C 1000mAh Battery	\$8.99	1	\$8.99
Hobby King	3S 30C 8000mAh Battery	\$44.11	1	\$44.11
Hobby King	Deans XT Plugs (10 pairs)	\$3.08	2	\$6.16
Hobby King	12 AWG 1 meter wire BLACK	\$2.49	3	\$7.47
Hobby King	12 AWG 1 meter wire RED	\$2.49	3	\$7.47
!McMaster-Carr	5/8" Aluminum Tubing 6'	\$16.38	1	\$16.38
!McMaster-Carr	3/32" Delrin 24"x48"	\$70.67	1	\$70.67
!McMaster-Carr	1/4" Delrin 12"x12"	\$27.87	1	\$27.87
!McMaster-Carr	4-40 5/8" Standoff	\$0.46	12	\$5.52
Amazon	Optima 7 RC Receiver	\$58.04	1	\$58.04
DIY Drones	Propellers 10x4.5 1 push 1 pull	\$6.00	2	\$12.00
Pololu	CHR-UM6-LT IMU Sensor	\$149.99	1	\$149.99

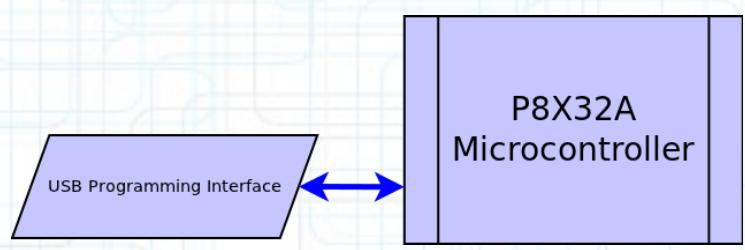
\$655.75 per quadrotor

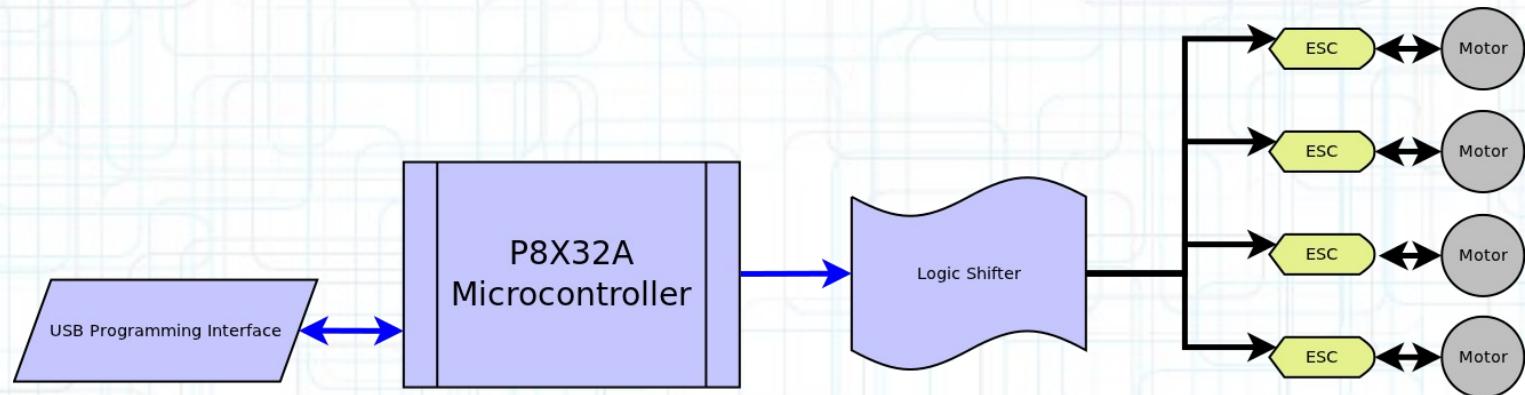


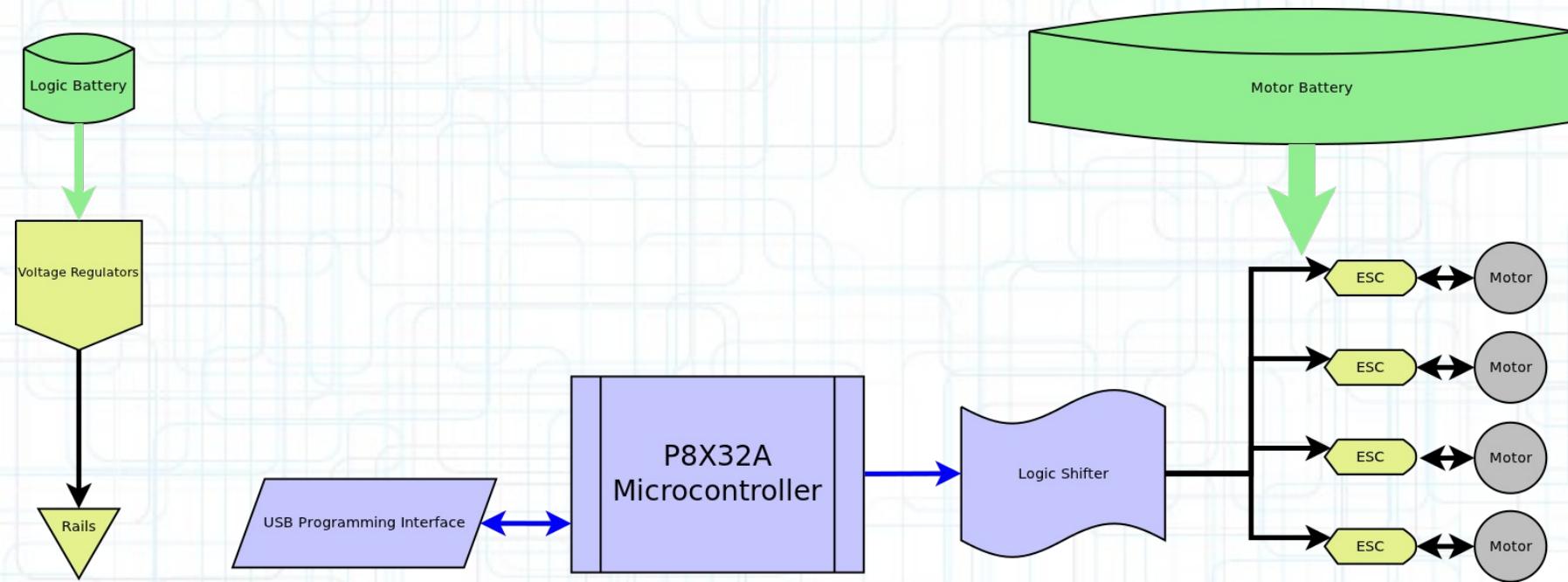
Specific Technical Goals

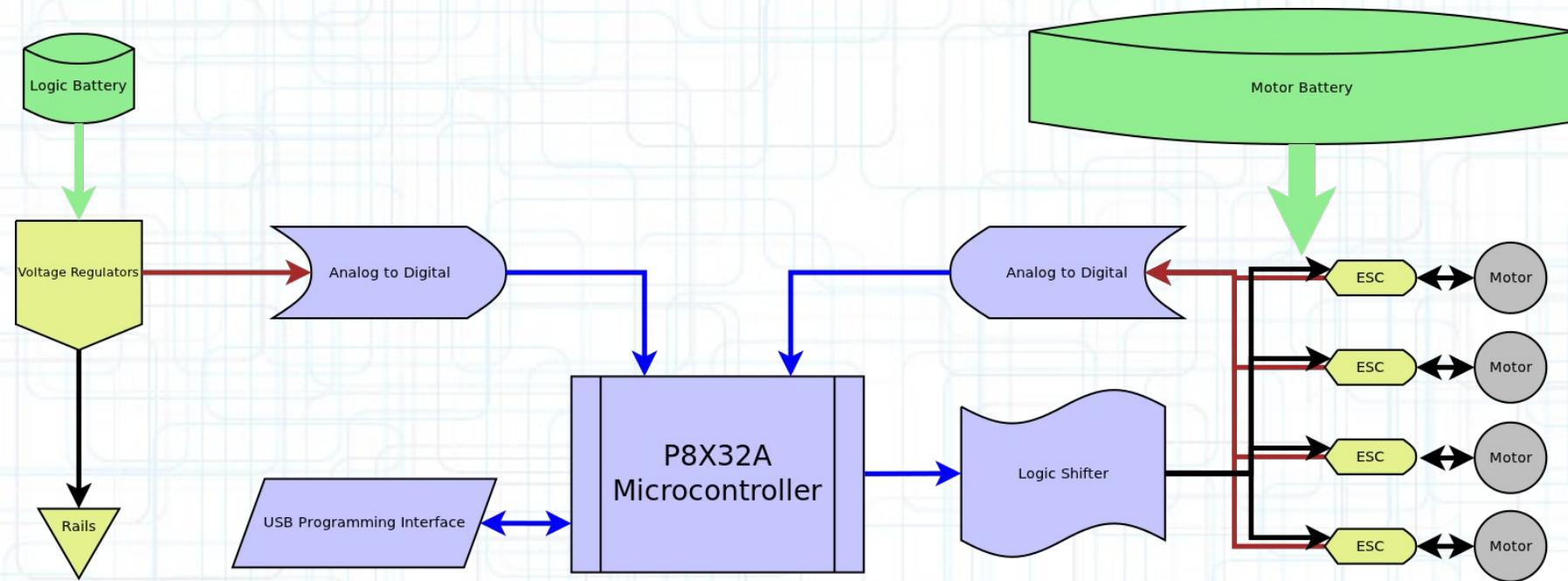
- Maintain pitch/roll/yaw to desired angle
- Traverse to desired position
- Carry a payload of small video camera
- Be able to yaw/tilt payload

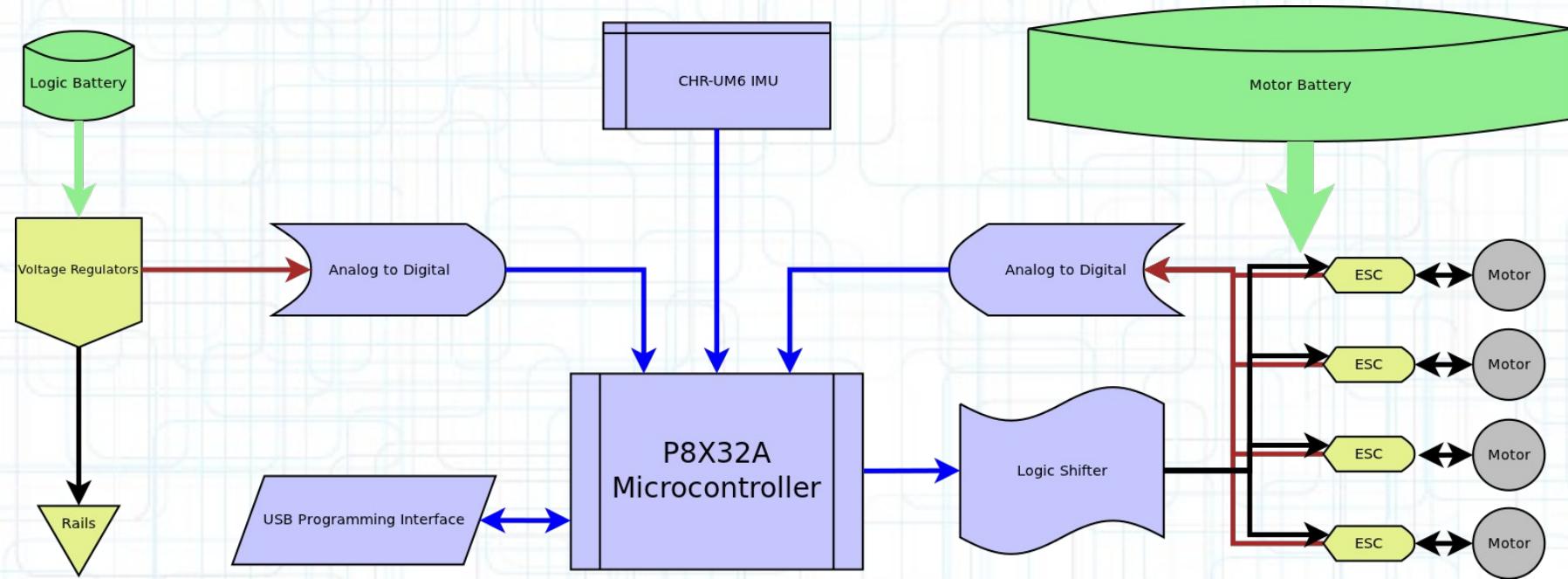
Architecture

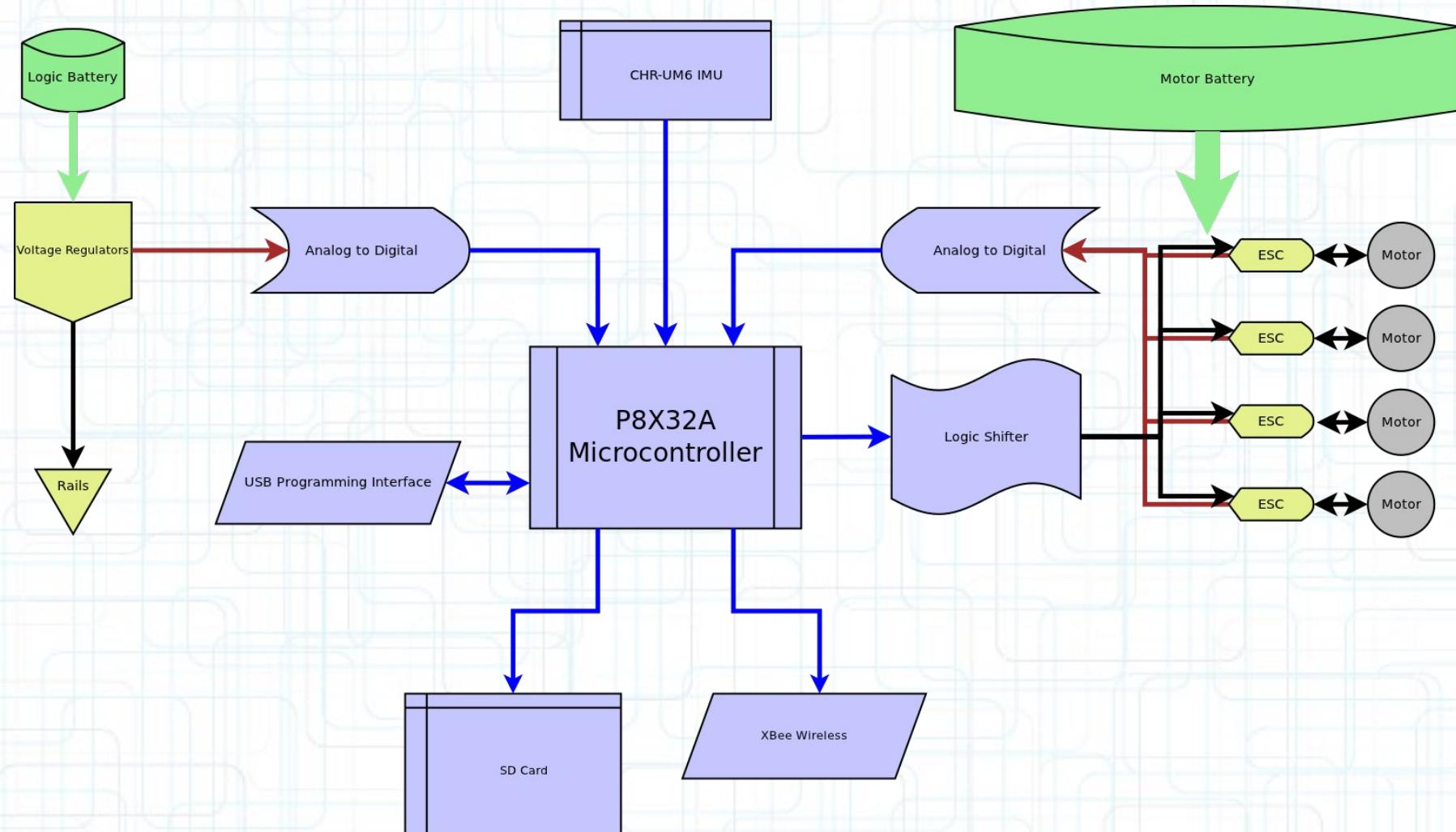




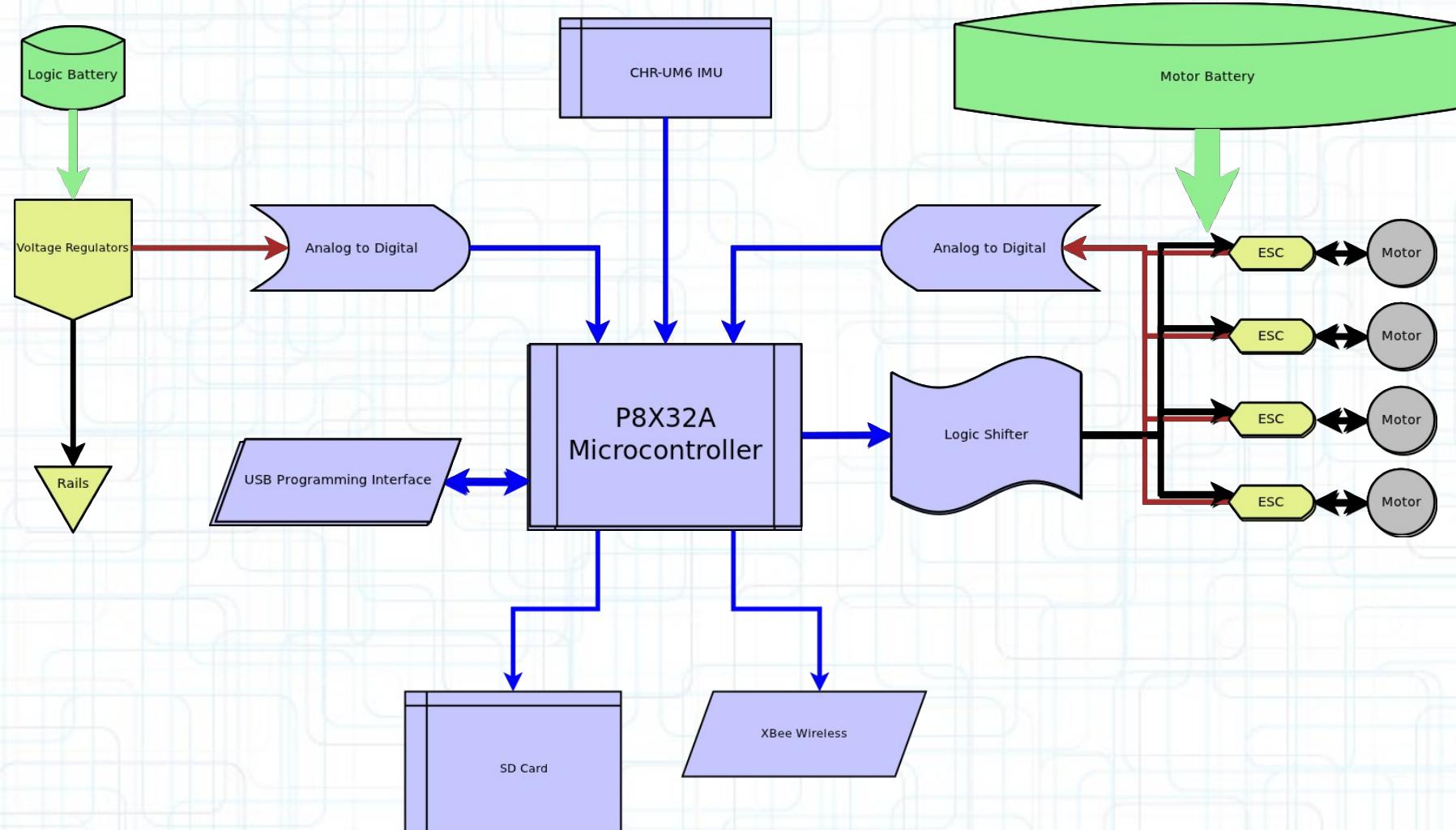








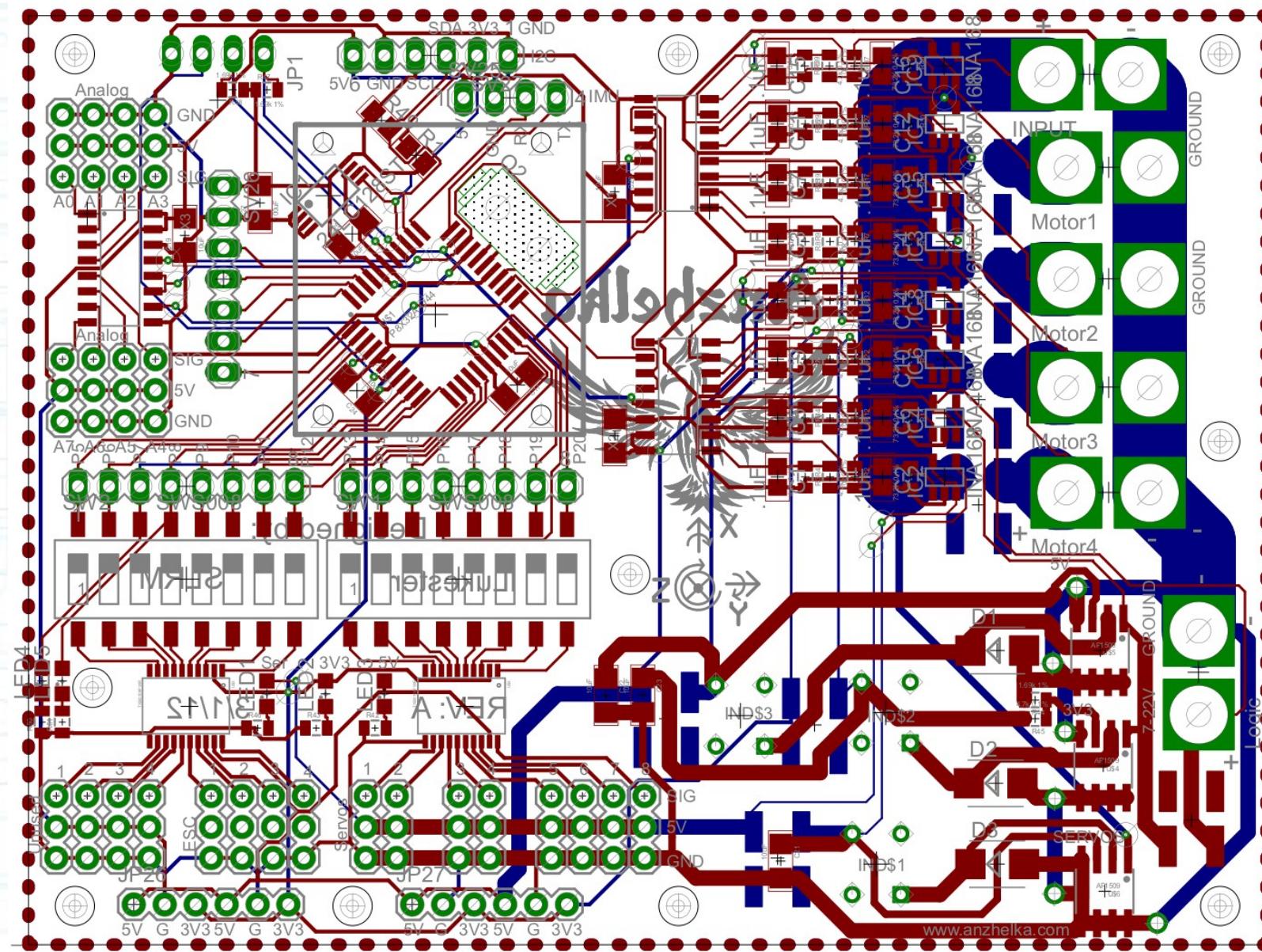
Do not Delete: overlaid slide



Features

- Propeller Multicore Processor
- Buck regulators for 5v (x2) and 3.3v
- Level shifting for up to 24 I/O lines
- Voltage and current sensing for
 - Motors, 5v and 3.3v rails
- 8 free analog channels
- Mounting accommodations for
 - SD card, IMU, Quickstart, BoE formfactor
- Servo and I/O 3 wire headers (WRB)

Rev A PCB



Anzhelka

Tasks

<http://www.jasondavies.com/wordcloud/#>

Test~Motors
Design~PCB
Populate~PCB
Select~Frame
Build~Frame
Research~Control~Algorithms
Select~Hardware
Write~Drivers
Code~Algorithm
Develop~Motor~Test~Stand
Create~Project~Management
Document~Project

Tasks



Joint effort on all tasks

No arbitrary division of labor

Testing

- Motor thrust/torque
- Attitude Measurement
- Attitude Error
- Roll/Pitch
- Yaw
- Altitude

Design Considerations

- Realistic constraints
- Industry Standards
- Time/Skills

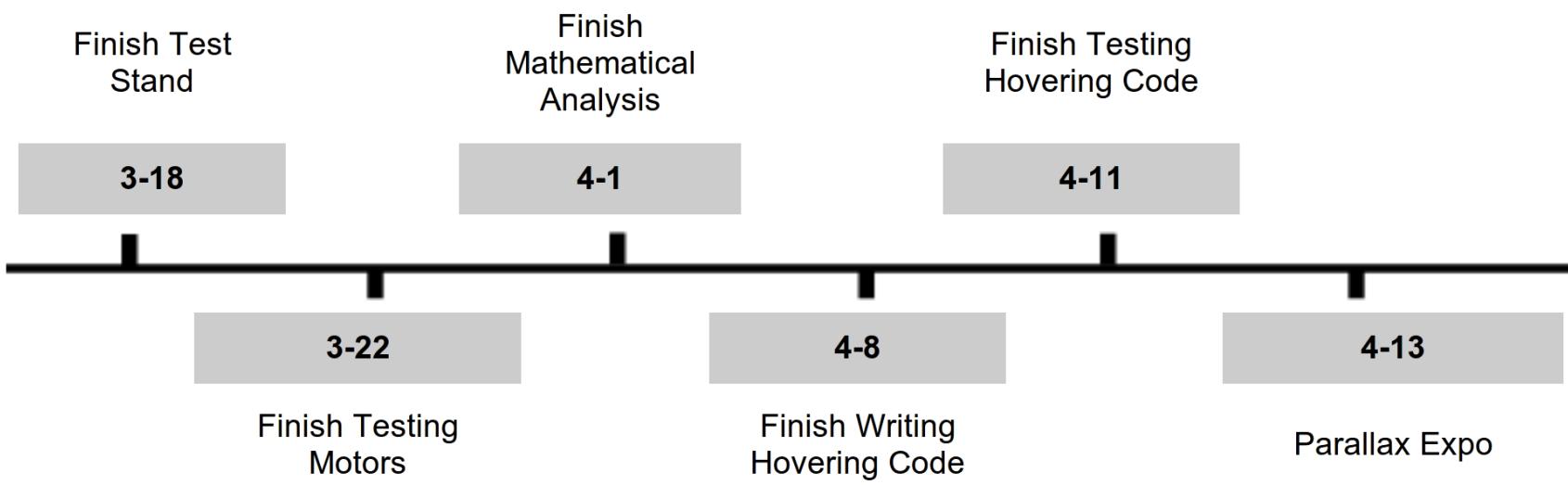
Technical Challenges

- Quadrotors have a hard realtime requirement
- High current motors require special precautions
- System-wide part compatibility and interfacing

Summary of progress

- Analyzed most needed control algorithms
- Designed main control board (Rev A)
- Developed motor test stand
- Designed and implemented project management

Next Steps



Acknowledgement

- Machining: Dale Holtkamp and Gene Sherman
- Algorithms: Frank Lewis and Emanuel Stingu
- Design: Dr. Liang, Dr. Kastner, Tom Wypych
- Workshop: Elmar Palma
- Other: Mr. Chehisch (Luke)

Conclusion



All done!

