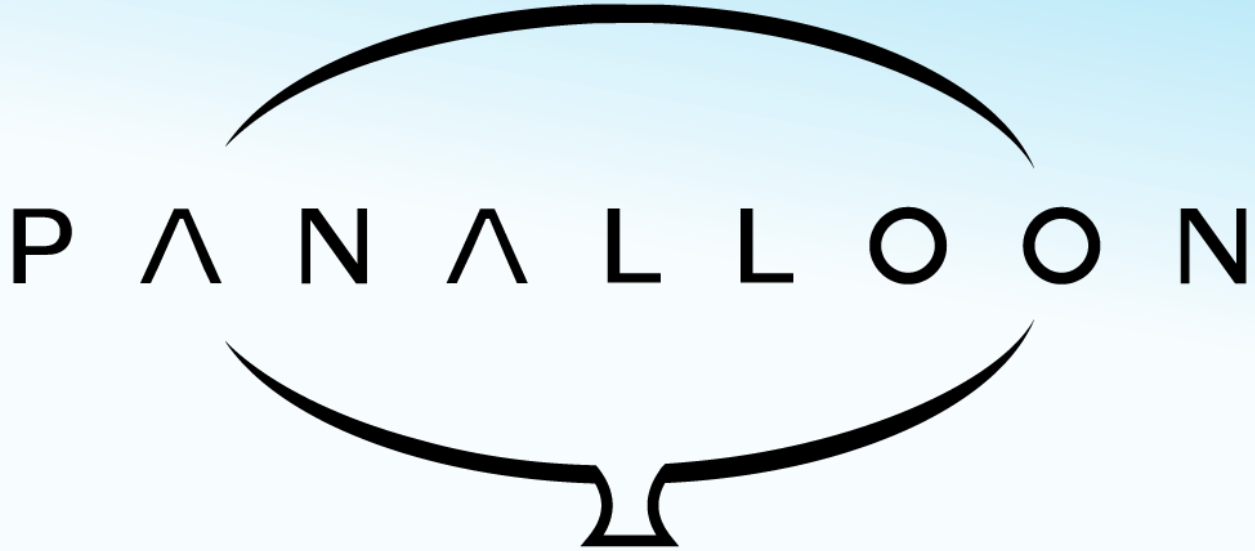
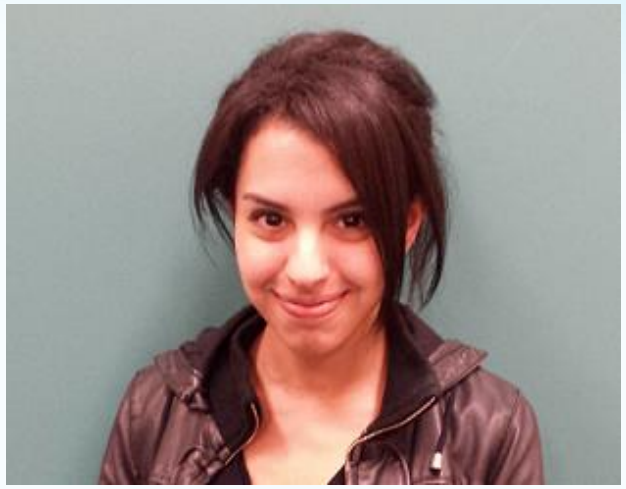


Presents

SkySeed

Members of Panalloon Systems



Sarah Elmasry (COO)

Software Engineer

- Wi-Fi client/server Development
- GUI Design/Development

Shayan Azizbeaigi (CFO)

Test Engineer

- Aerial Netting and Links
- Logistics

Members of Panalloon Systems

Michael Nguyen (CDO)

Power Electronics Engineer

- Power Distribution /Safety Design
- Electronic Enclosure Design

Milad Bonakdar (CTO)

Software Engineer

- Wi-Fi client/server Development
- GUI Design/Development

Members of Panalloon Systems

Amir Shamsuddin (CEO)

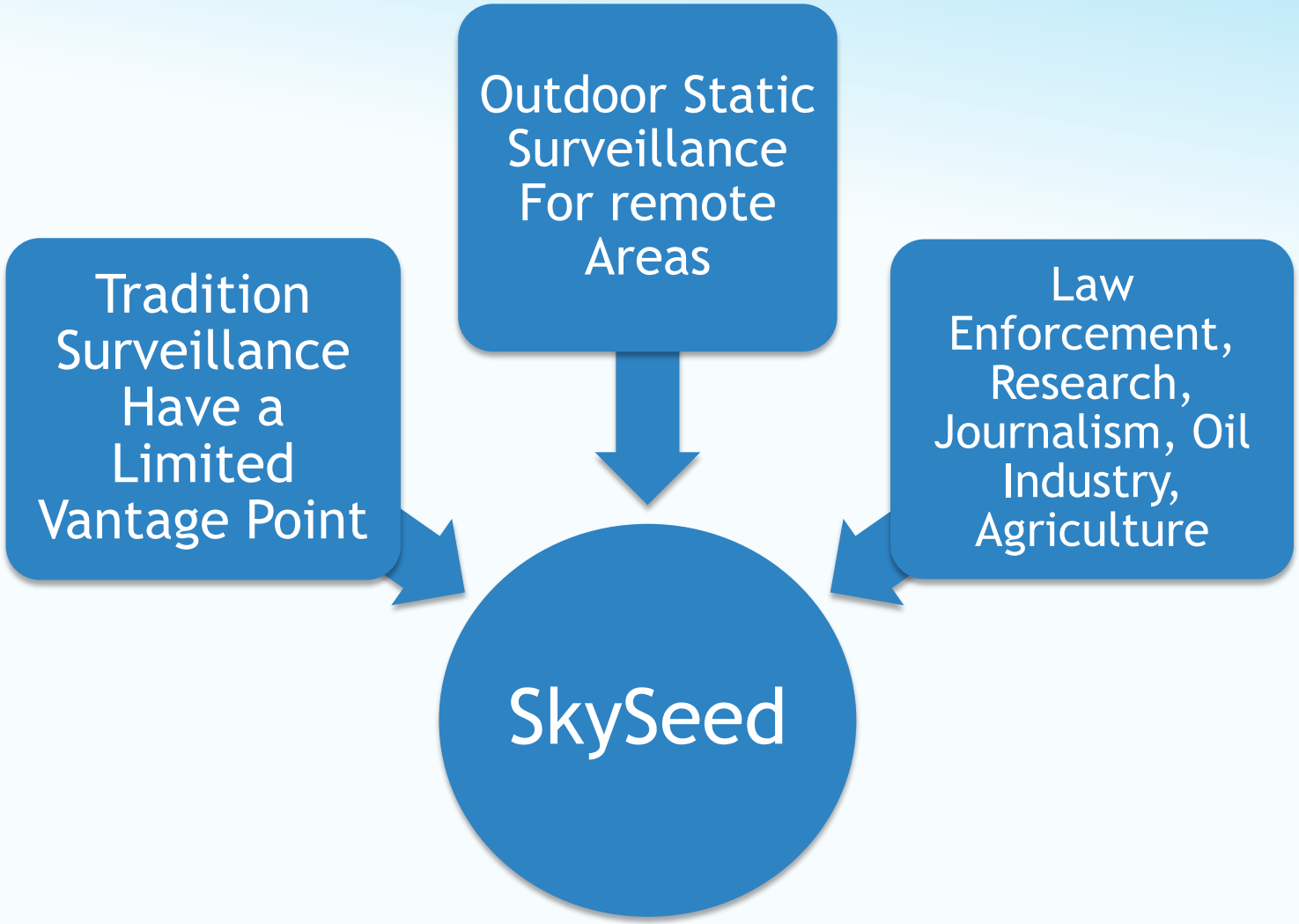
Embedded System Developer

- Sensor/Actuator Implementation
- SkySeed System Integration

Presentation Outline

- Motivation/Introduction
- System Overview
  - Aerial System
  - IP Camera
  - Motion System
  - SkySeed Software
  - Wireless Network
  - Power System
- Project Planning
- Materials & Cost
- Future of SkySeed
  - Product Improvement and Business
- Conclusion

Motivation


Outdoor Static Surveillance For remote Areas
Tradition Surveillance Have a Limited Vantage Point
Law Enforcement, Research, Journalism, Oil Industry, Agriculture
SkySeed

Motivation

Introducing SkySeed

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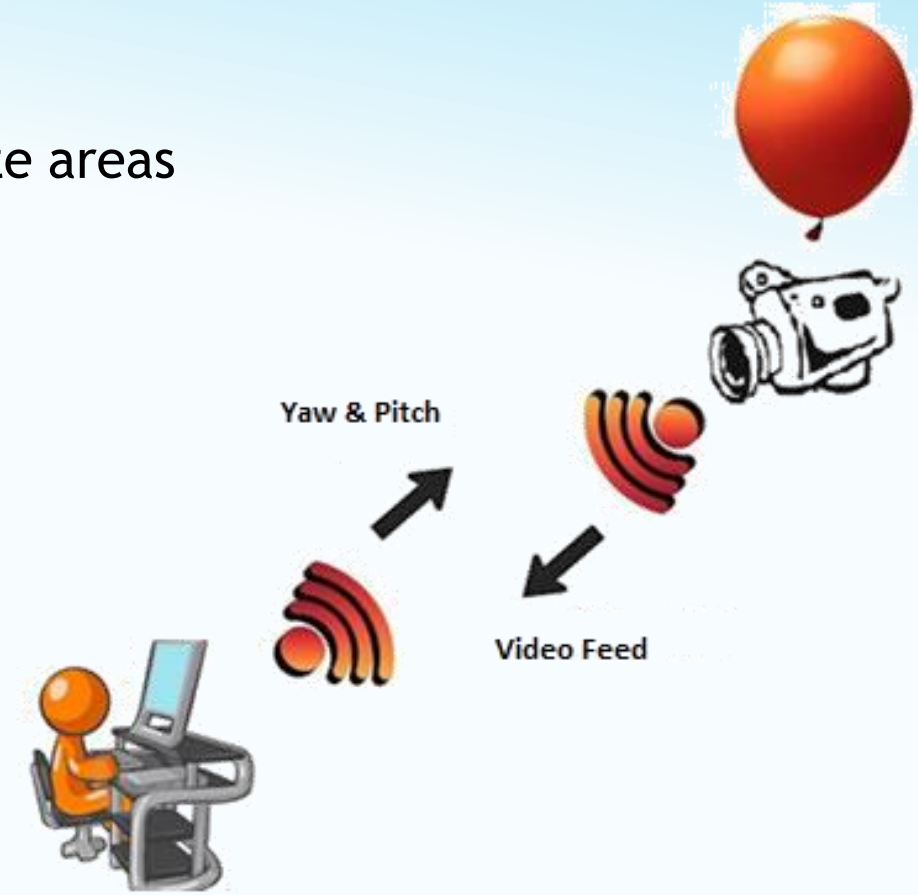
Proposed solution:

- Surveillance system for monitoring large/remote areas

System Characteristics:

- Height provided by a helium balloon
- 360º camera rotation for a Panoramic View
- Real-time wireless video stream and control



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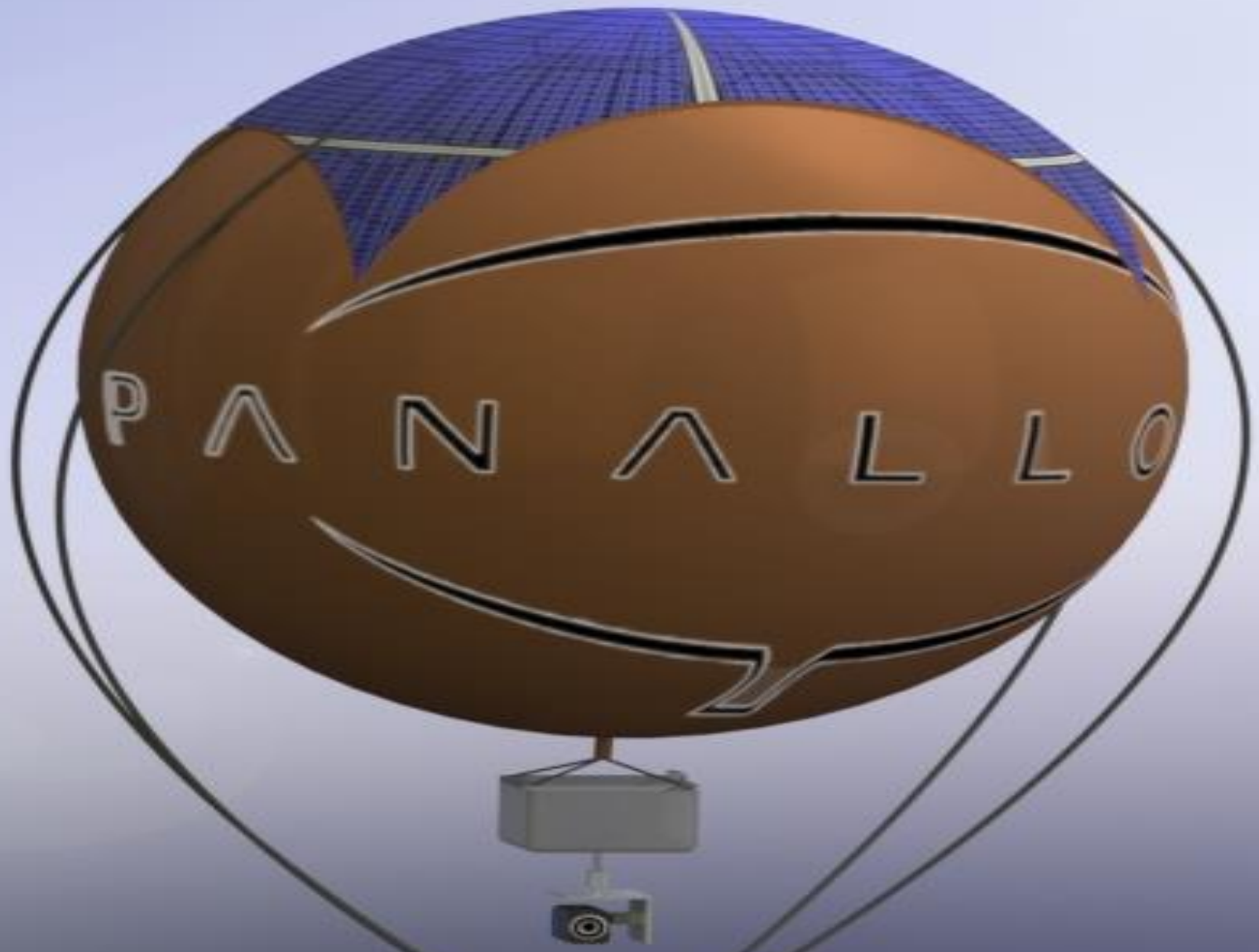
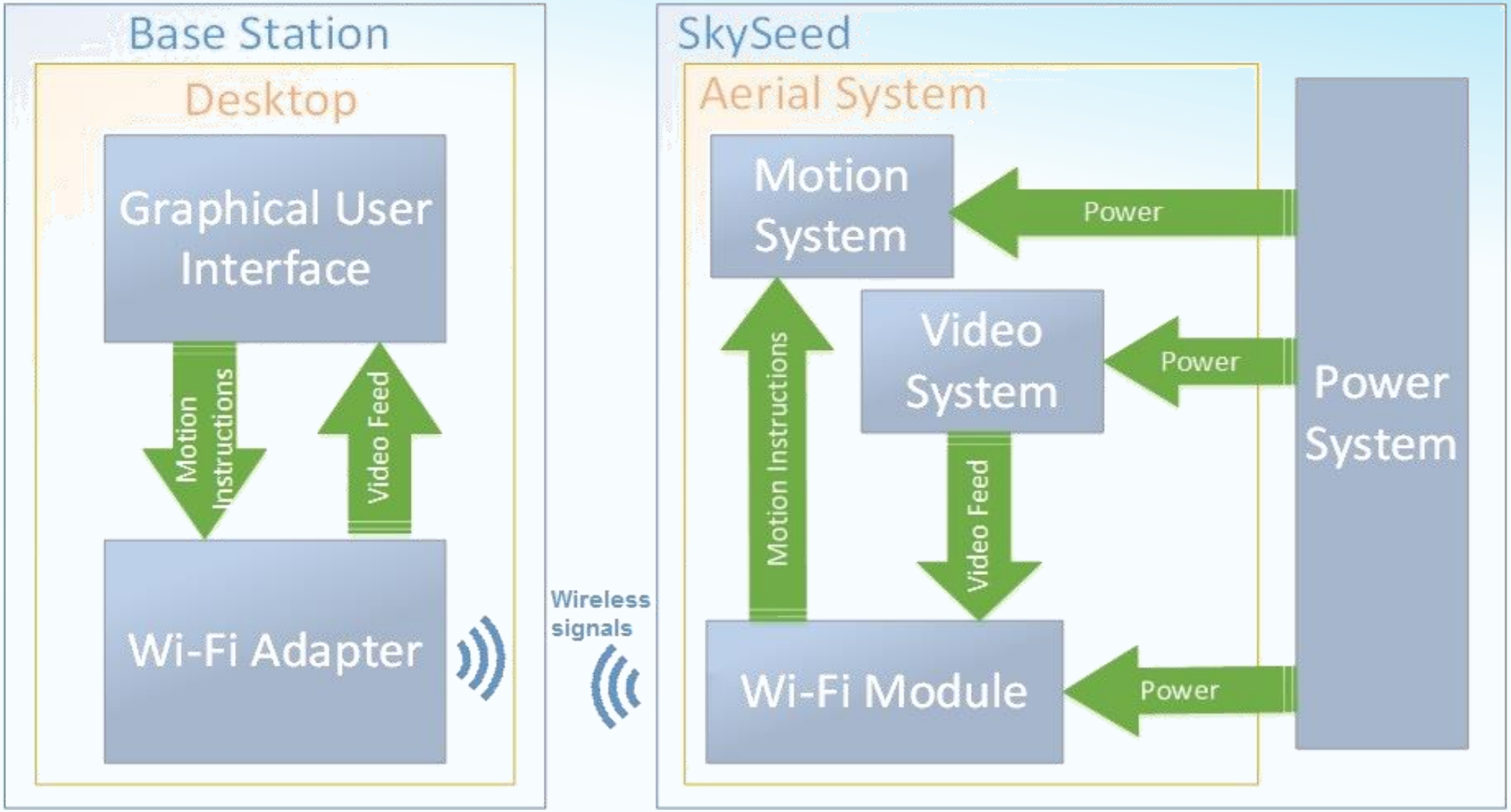


System Overview

Five Sub-Systems:

- Aerial System
  - Balloon - Netting - Enclosure connection
- Surveillance IP Camera
- Motion System
  - Servo - Bracket
- Wireless/Software
  - User Interface - Arduino Program – Network
- Power System
  - Safety – Distribution - Consumption

SkySeed Block Diagram



Aerial System: Balloon

Why Helium balloon?

- Why not hot-air balloon?

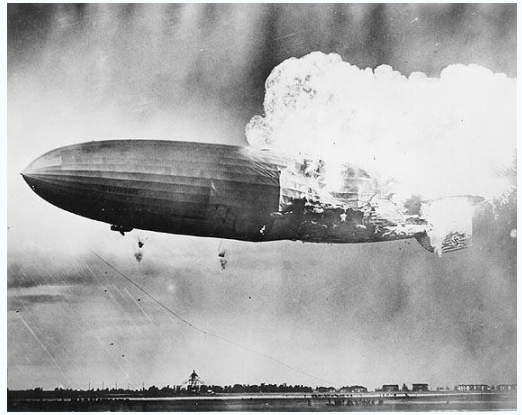
  High risk & cost, Excessive training required

- Why not a drone?

  Pilotless, Longer flight time

- Why not Hydrogen

  Explosive, lift required



Monitoring the public,UK Police, April10th, [Online]http://www.telegraph.co.uk/news/uknews/law-and-order/9496230/Police-drones-could-be-used-to-monitor-public-from-sky.html

Aerial System: Balloon

Helium weather balloon:

- Chloroprene material
- 2.46 m^3 Maximum Helium volume
- Max lift of 2.3 kg
- Payload Weight of 1.1 kg
- Actual Lift of 1.78 kg

Panalloon Systems, Design Specification for SkySeed, Simon Fraser University, Burnaby, BC,

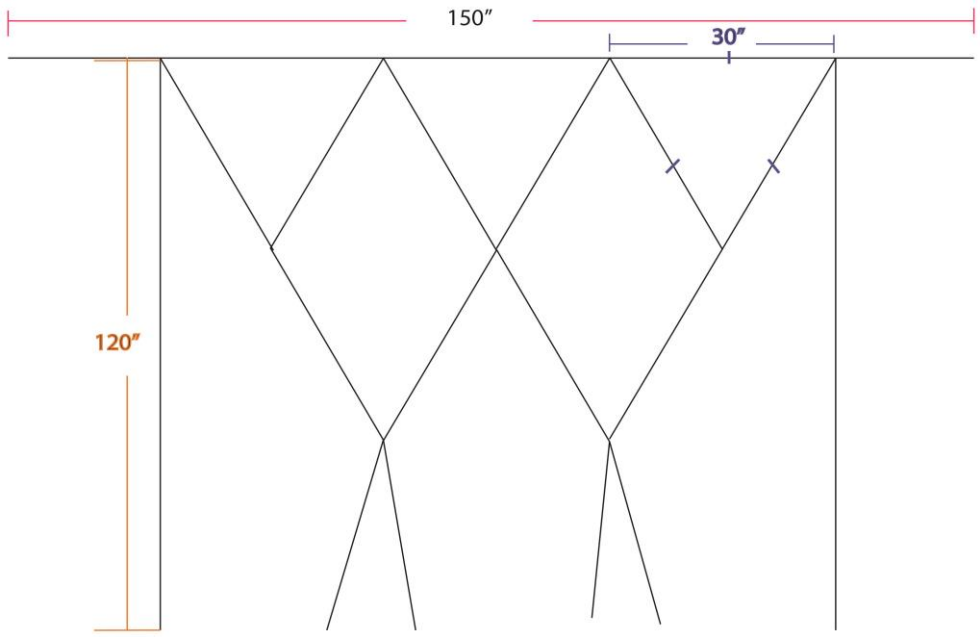
Aerial System: Balloon

Challenges with Helium balloon

- Expensive
  - $150 per medium size canister
- How much helium is enough?
  - No pressure gauge for inside balloon
- Not durable
  - Popped two balloons
  - Have to wear gloves

Aerial System: Netting

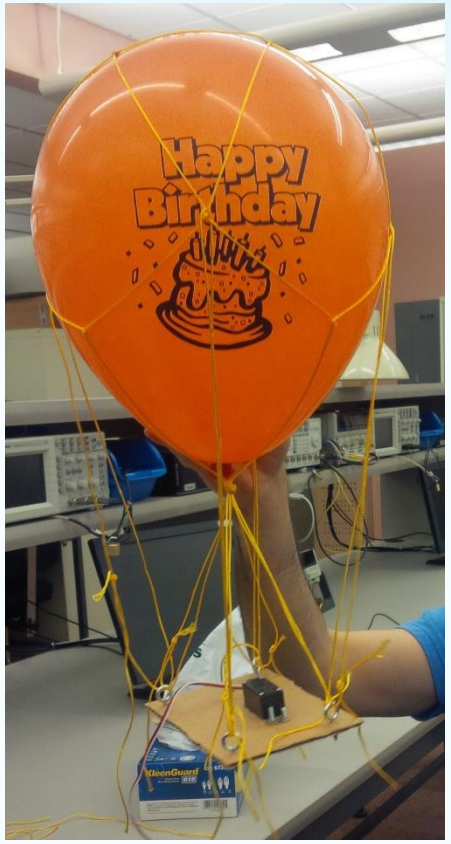
Purpose: Distributes system weight to reduce stress points

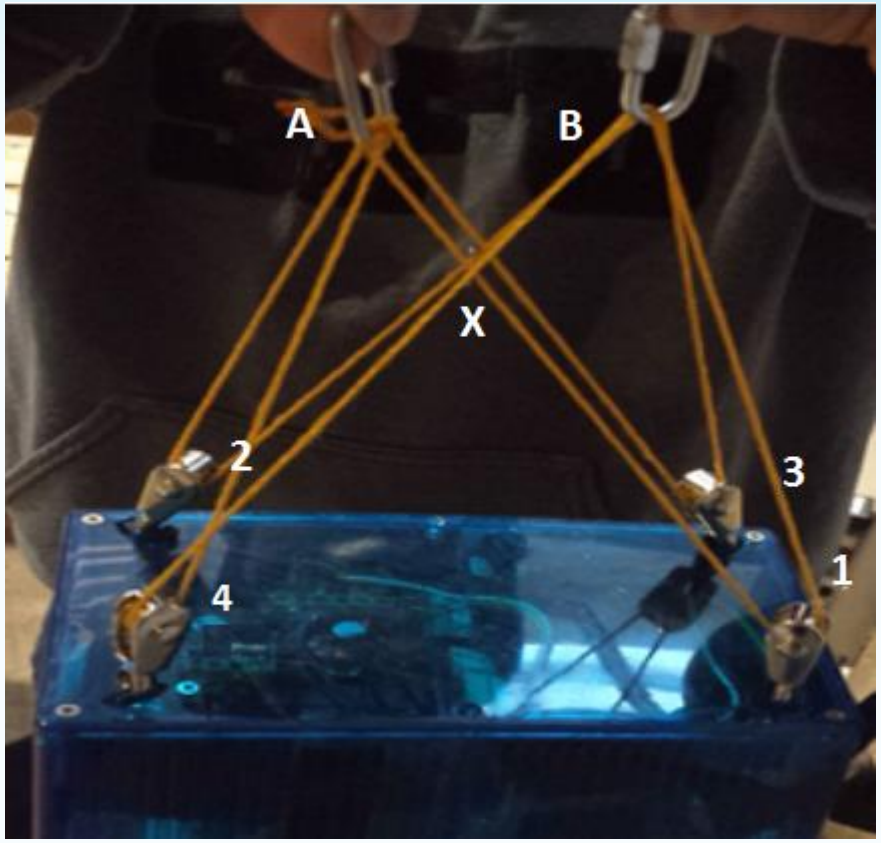


Aerial System: Enclosure Links

Stabilize payload

- Keeps enclosure parallel to the ground
- Convenient to detach from balloon netting





Paul Illsley.Unkown,Unknown,[online]. Available: http://www.paulillsley.com/airphoto/systems/balloons-kites.html

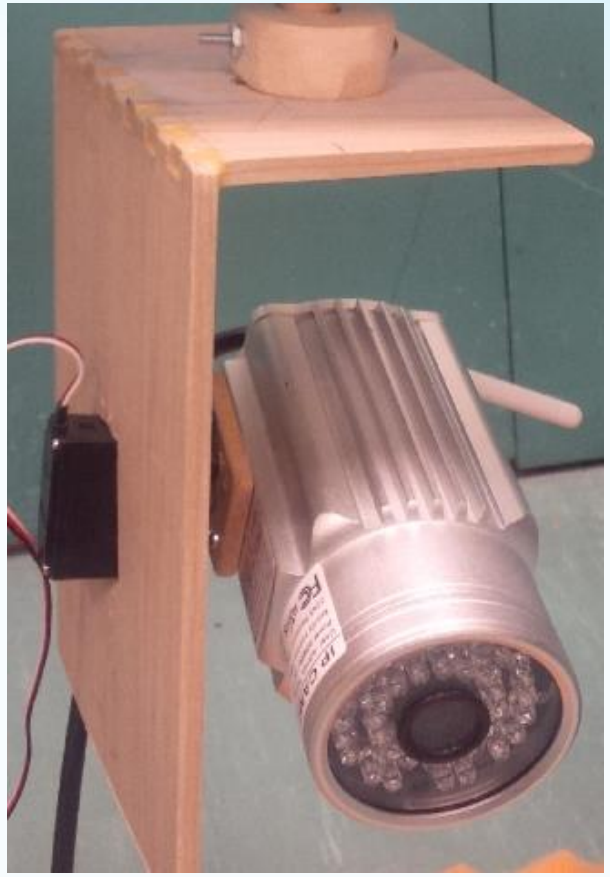
Surveillance IP Camera

Specifications:

Picture Resolution	**1280 x 720**
Frame Rate	5 – 25 fps
Video Compression format	H.264
Wireless Standard	802.11 b/g/n RJ-45
Network Security	WEP/WPA/WPA2 encryption support
Network Protocol	HTTP FTP TCP/IP UDP SMTP DHCP PPPoE DDNS UPnP
Power Consumption	DC 12 V / 1 Watt
Night Vision	Yes

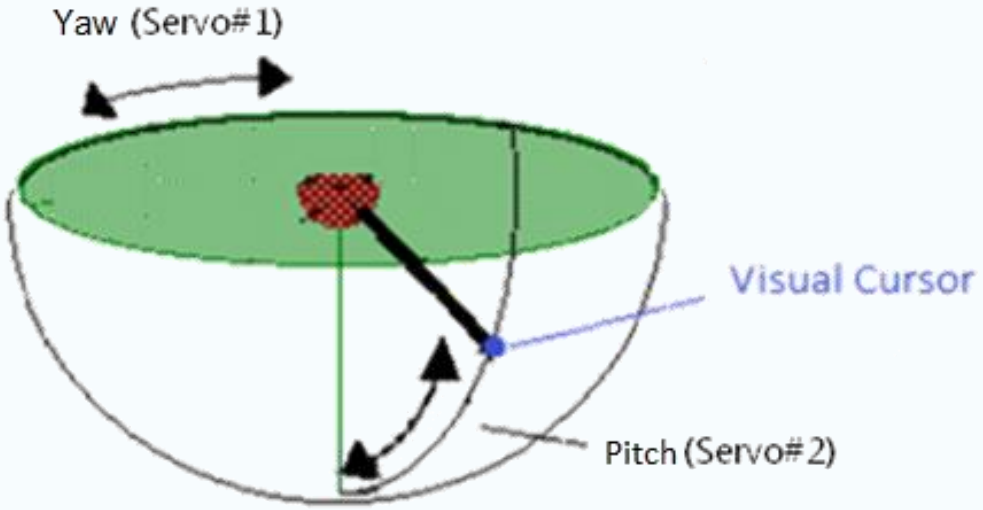
Panalloon Systems, Design Specification for SkySeed, Simon Fraser University, Burnaby, BC,

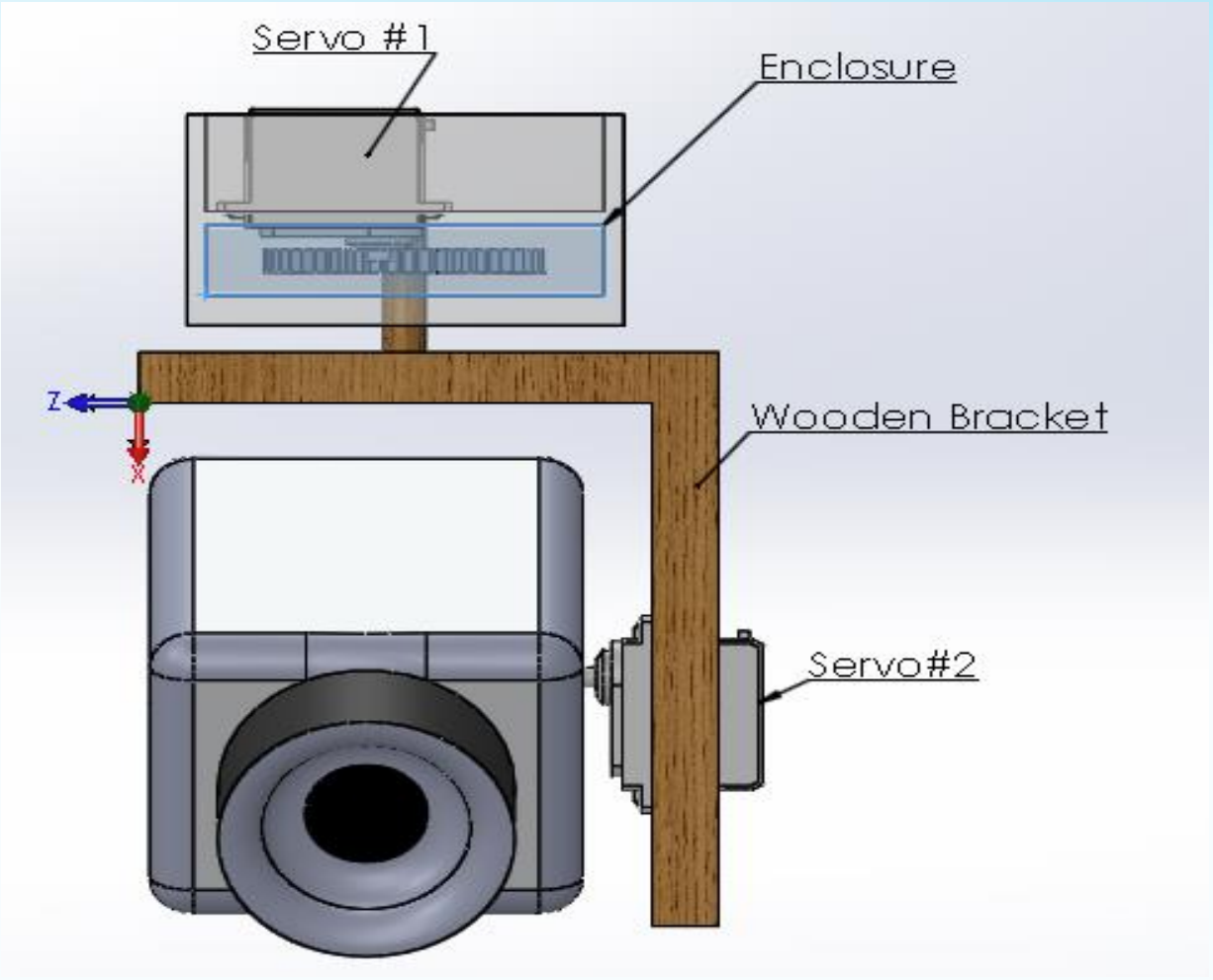
Weight reduction: 700 g → 250 g



Motion System

- Servo #1 Continuously rotate about x-axis
- Servo #2 Rotates about z-axis





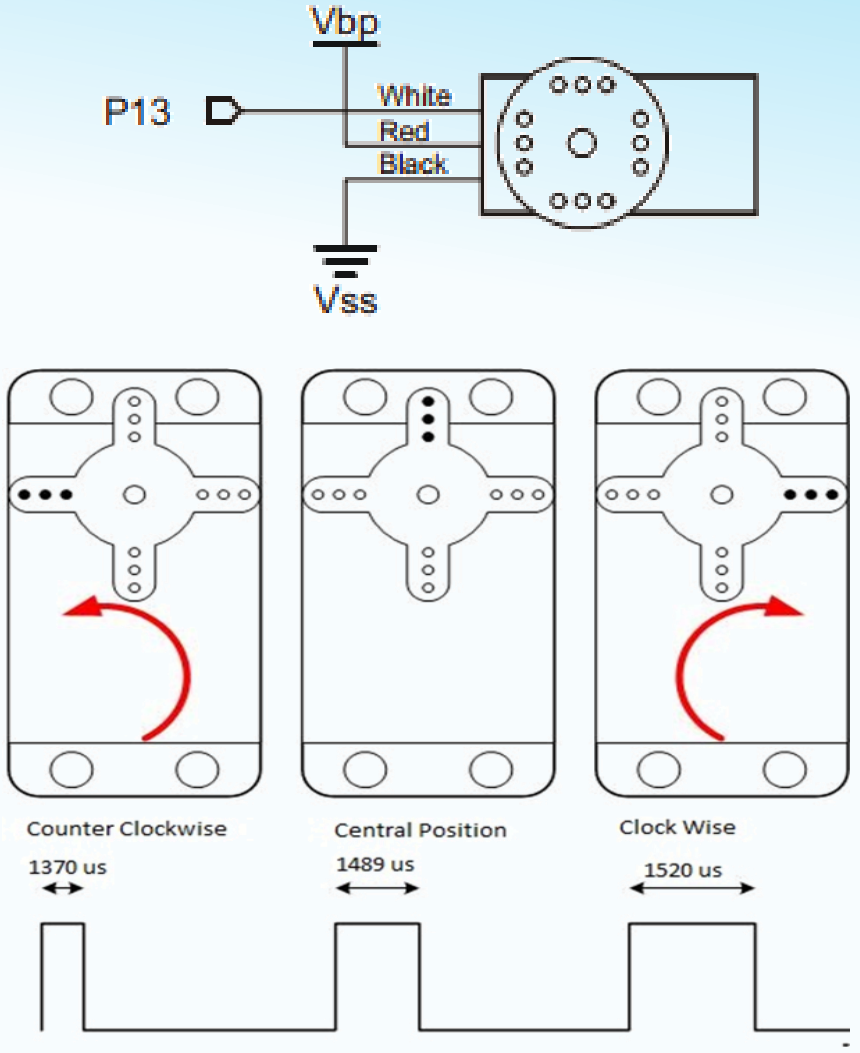
Motion System: Servo Motor

3 Pin PWM Servo

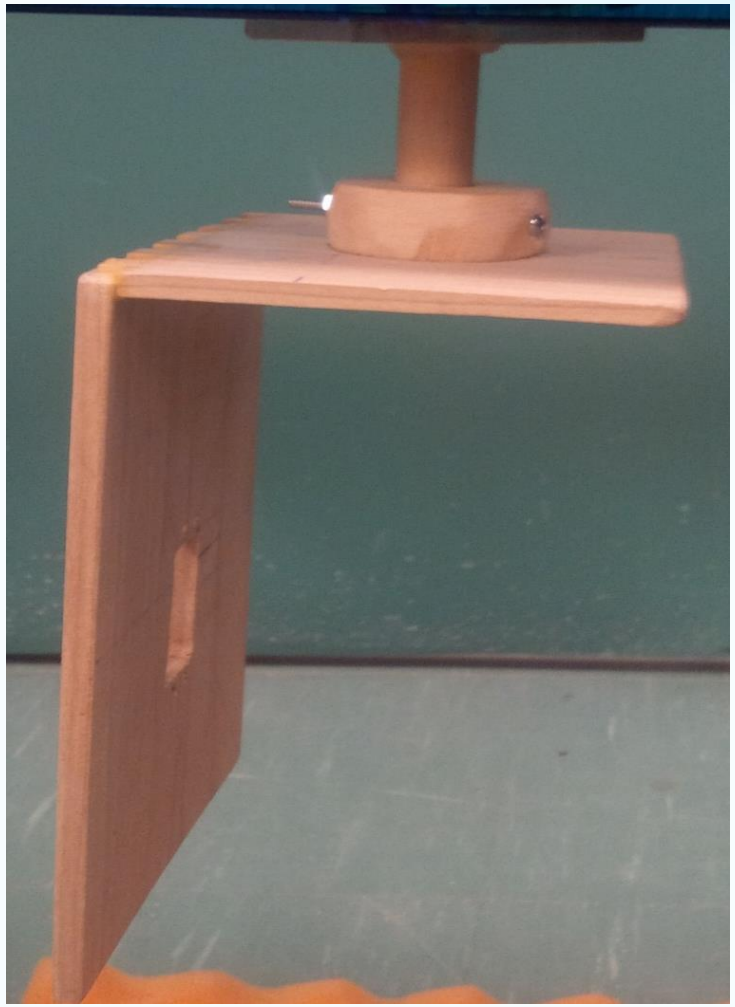
- Stall current of 1 A

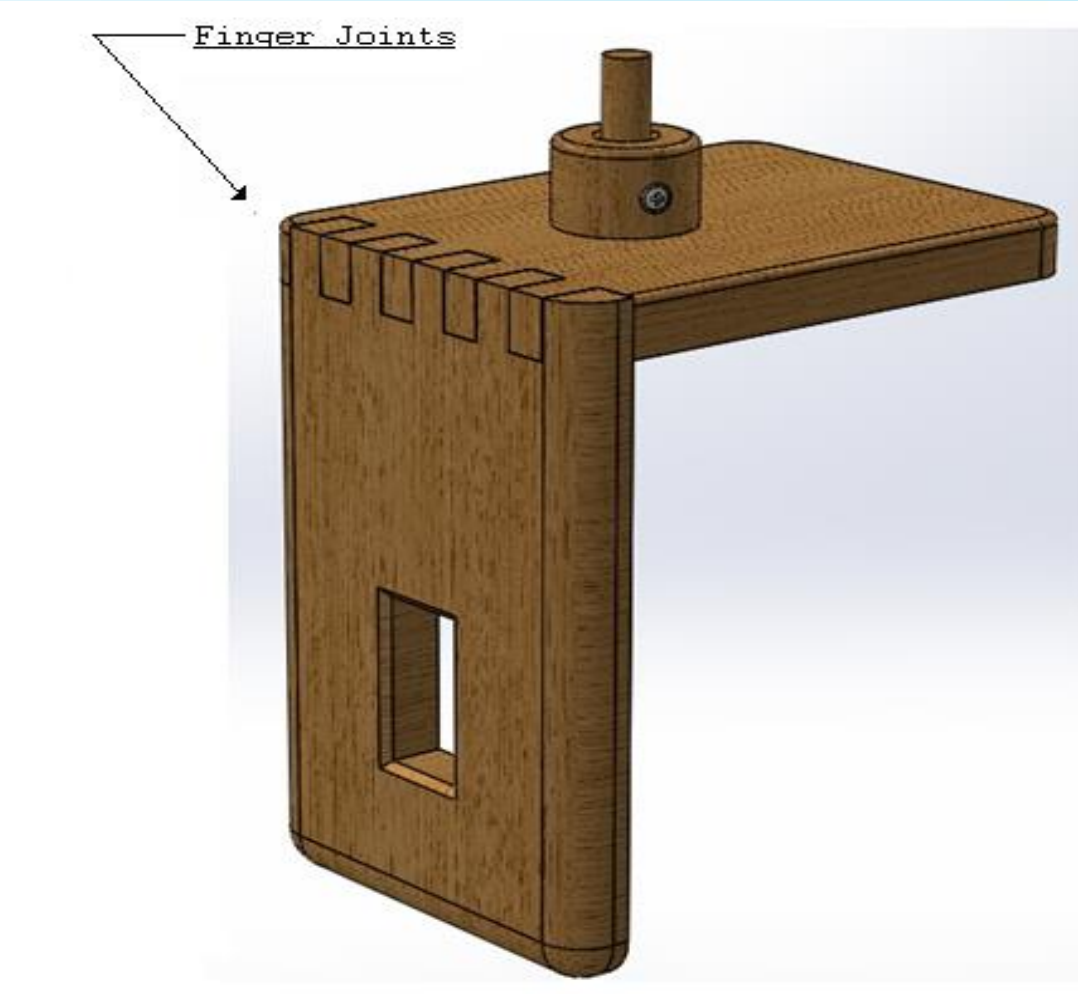
At Current payload:

- Servo #1 (Yaw)
  - ~ 100 mA measured
- Servo #2 (Pitch)
  - ~ 100 mA measured



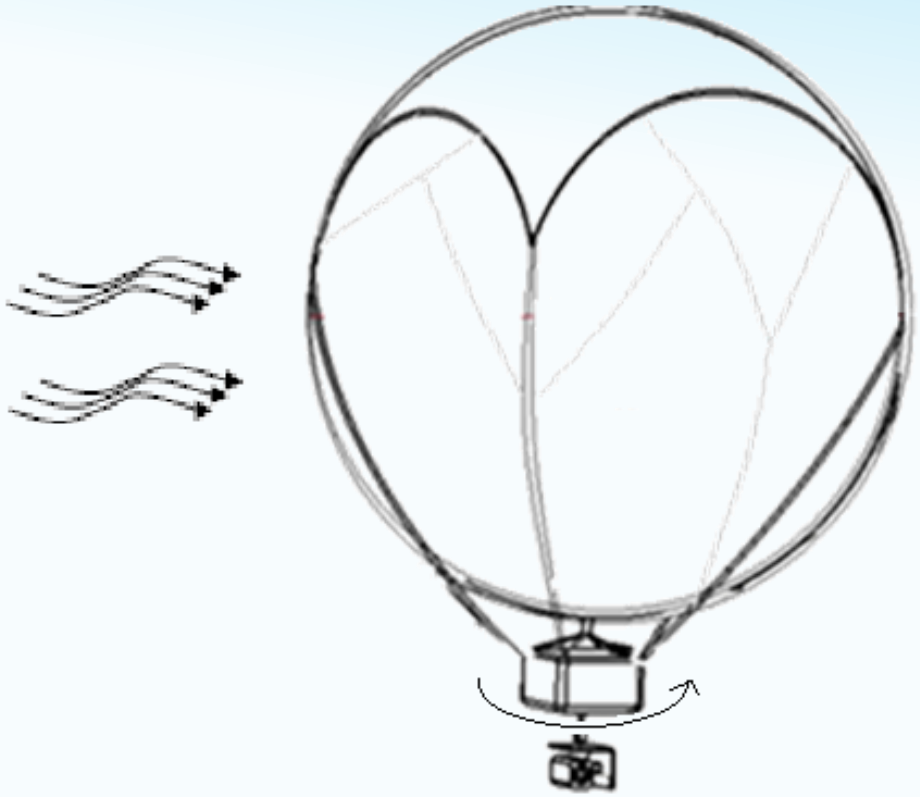
Motion System: Wooden Bracket



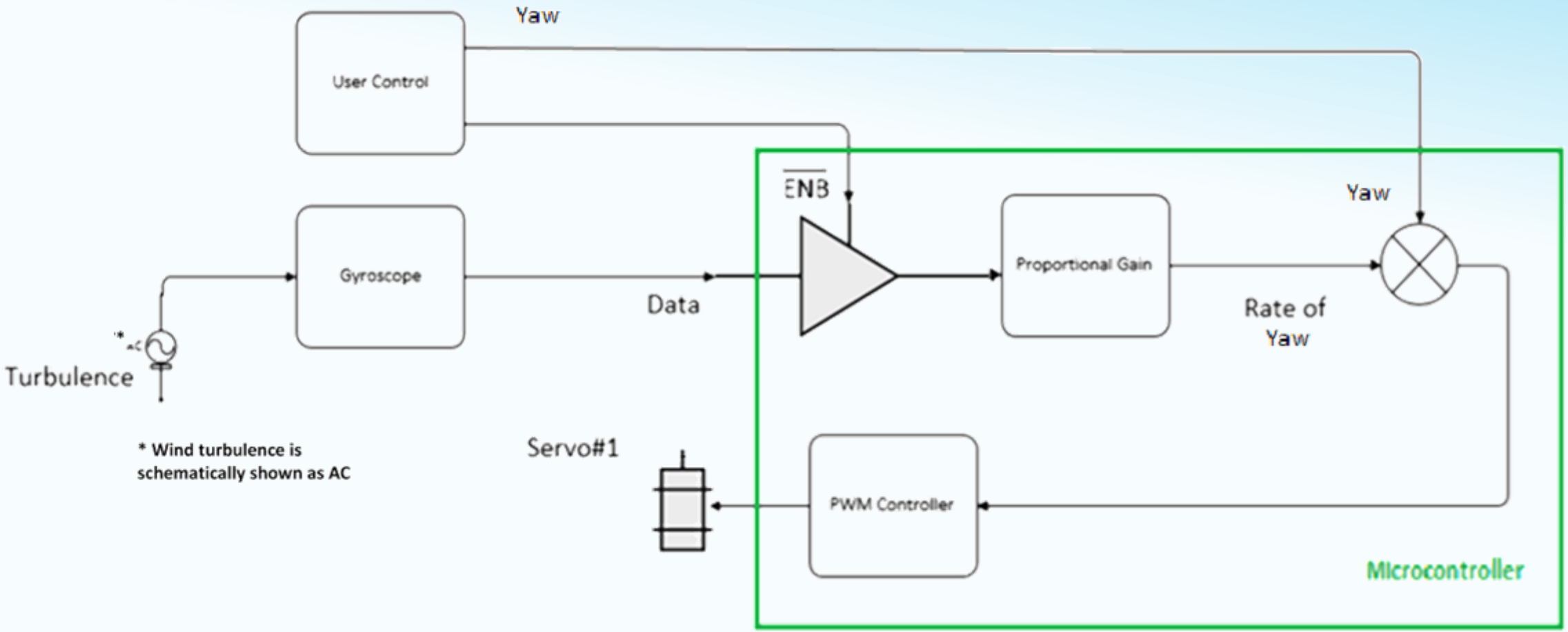


Motion System: Motion stabilizer

- Torque applied by wind



Motion System: Motion stabilizer



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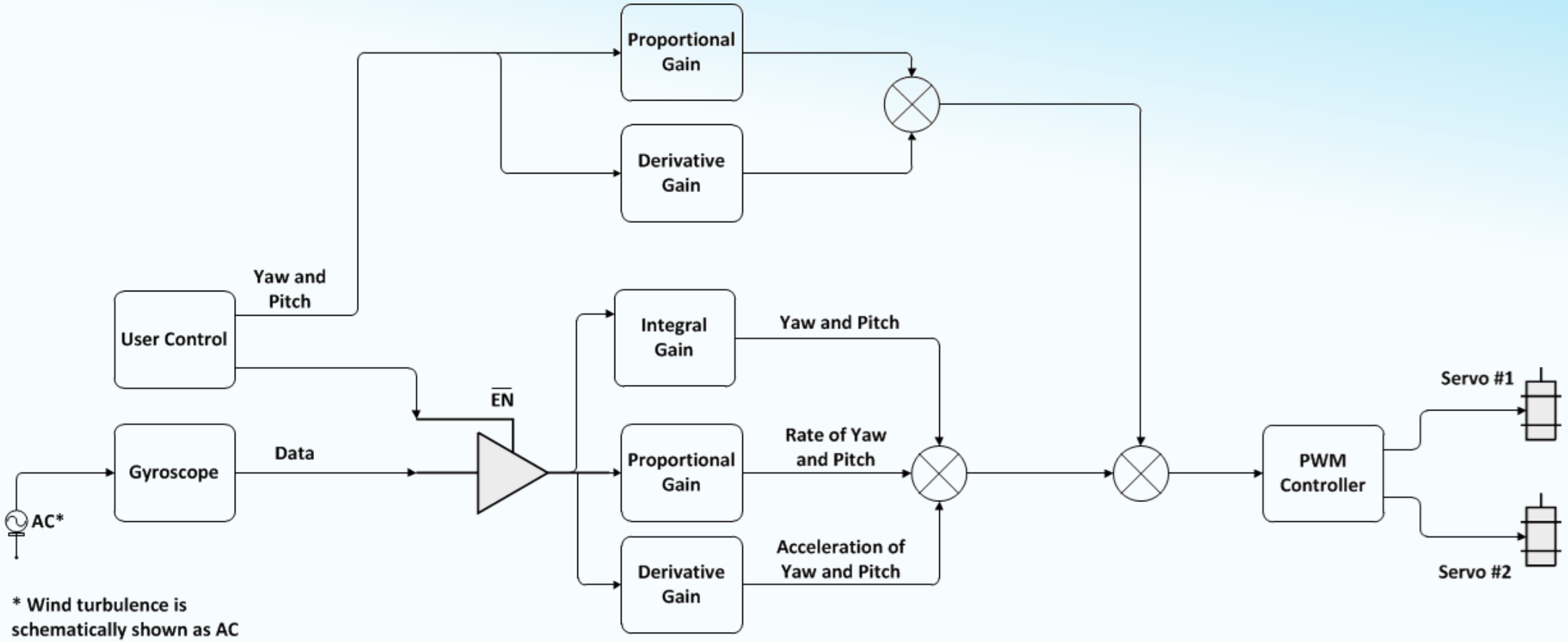
Motion System: PID Stabilizer



SkySeed Software: Arduino Program

- Purpose: SkySeed Brain
- Acts as a Wi-Fi server accepting up to 4 incoming client connections from UI
- Receives user input through Wi-Fi shield
- Processes user input and controls servo motors accordingly

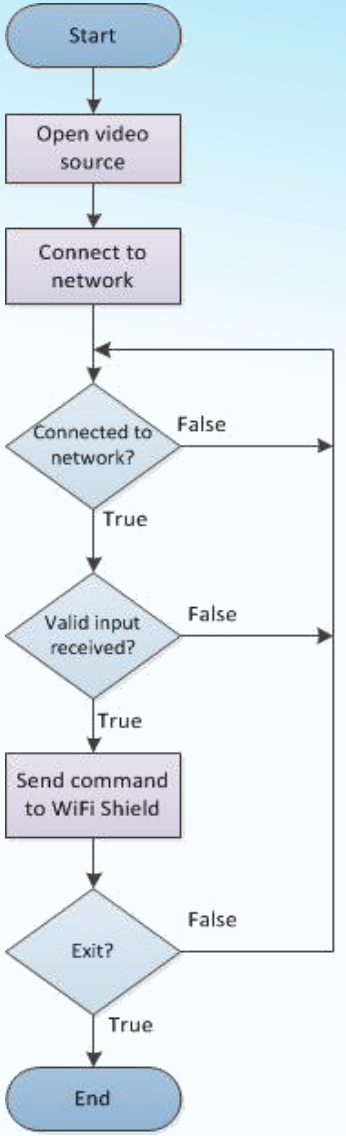
SkySeed Software: User Interface

Features:

- Control camera orientation
- Select from 3 speed options
- Stream video feed
- Record video stream
- Rotate image

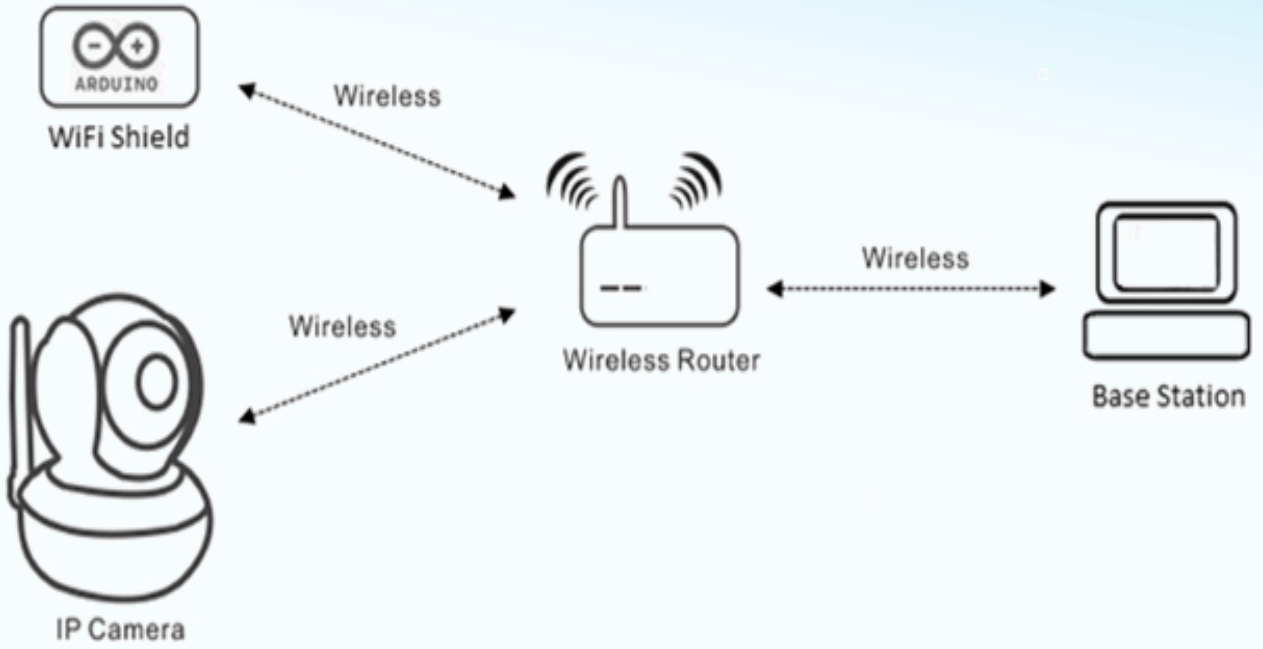
SkySeed Software: User Interface

- Developed using C# Windows Form application
- Video stream capability implemented using Aforge.NET library
- UI serves as TCP socket client
- Compatible with up to 4 UI sessions at once



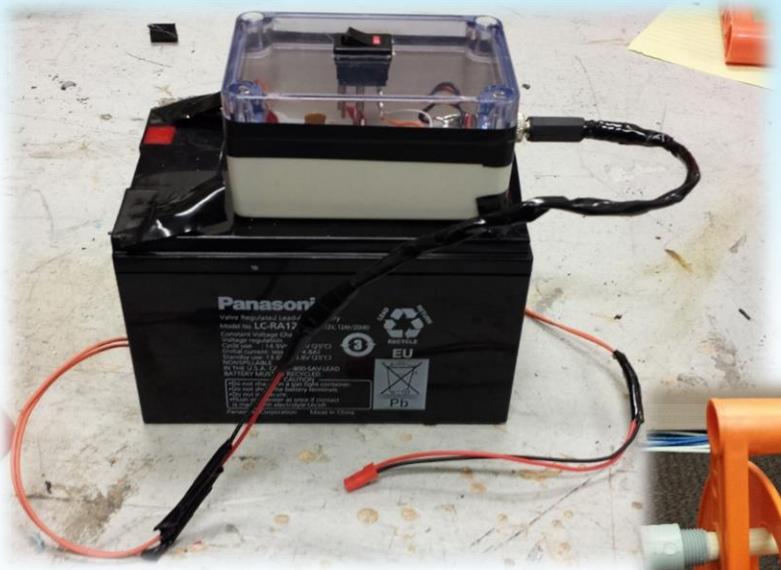
Wireless Network

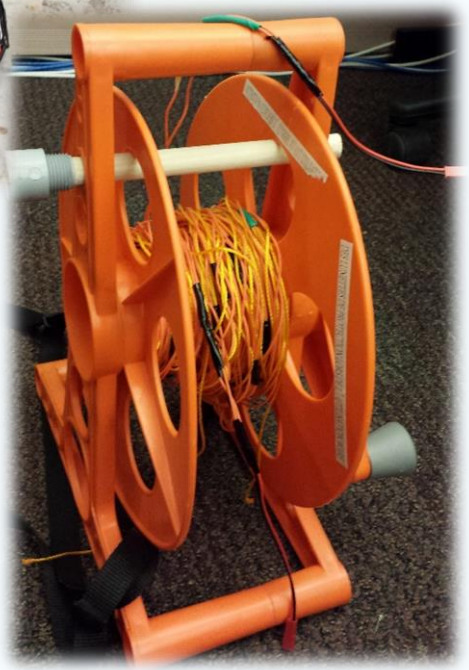
- Wi-Fi Shield and IP Camera are assigned fixed IP addresses
- Server: Wi-Fi Shield
- Client: Base Station / UI
- Client/Server connection uses TCP sockets



Power System

- **On-board battery**
  - Ideally want power source on SkySeed
  - Needs a battery technology with high power density (Ah/kg) e.g. Li-Ion
  - Not cost effective
- **On-ground battery**
  - Lead-Acid Battery (12 V, 12 Ah)
  - Safety features and Visual feedback
  - Connectors for usability
  - Enclosure to restrict access
  - Disadvantage: requires 20 m of cable

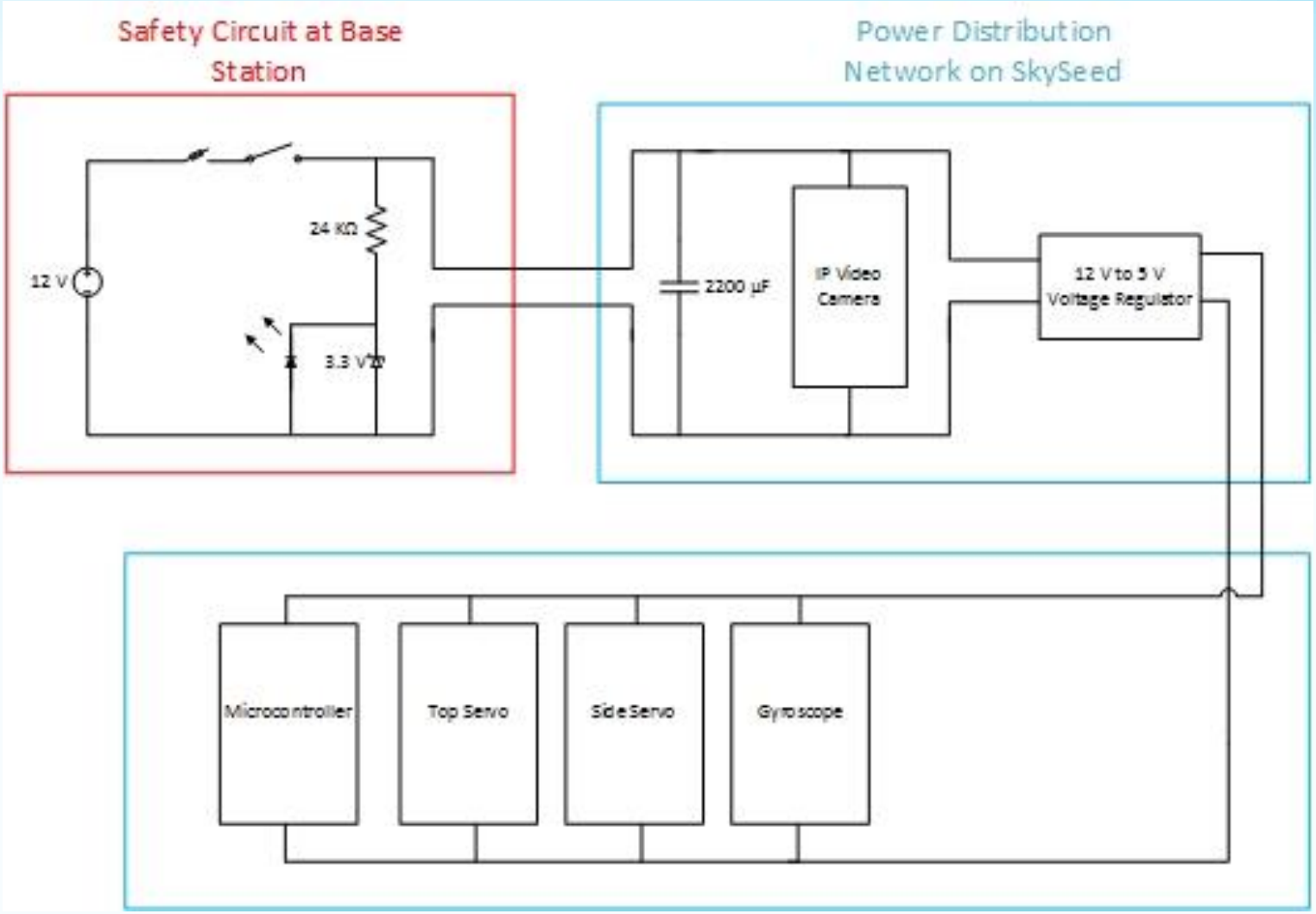




Power System

Safety and power distribution circuitry

- Power ON LED
- Resettable fuse (1.3 A)
- Reservoir capacitor (2200 μF)
- Bulk voltage regulator (12 V to 5 V)



Power System

Estimated Power Consumption			
Device	Current (mA)	Voltage (V)	Power (W)
Microcontroller	200	5	1.0
Top Servo	100*	5	0.5
Side Servo	100*	5	0.5
IP Camera	83.3	12	1.0
Gyroscope	7	5	0.035
Total	---	---	4.035

Measured Power Consumption			
Device	Current (mA)	Voltage (V)	Power (W)
Battery Terminals	403	12	4.836

- **Lead-acid battery (12 V, 12 Ah) provides 144 W**
- **SkySeed can operate for ~30 hours**

System Overview

Five Sub-Systems:

- ✓ Aerial System
  - Balloon - Netting - Enclosure connection
- ✓ Surveillance IP Camera
- ✓ Motion System
  - Servo - Bracket
- ✓ Wireless/Software
  - User Interface - Arduino Program – Network
- ✓ Power System
  - Safety – Distribution - Consumption

Project Plan

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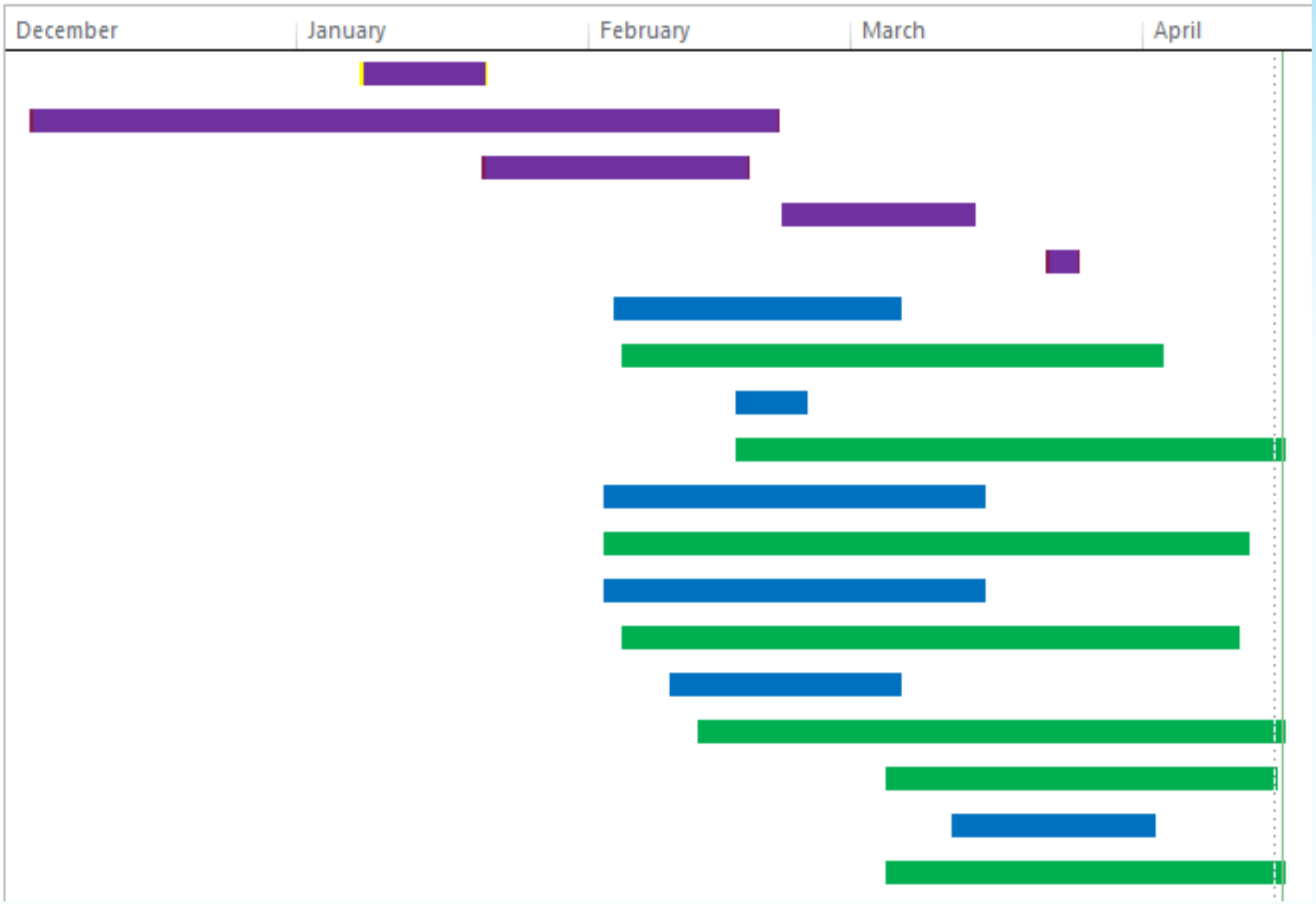
	Task Name	Duration
1	Project Proposal	9 days
2	Research	57 days
3	Functional Specificatikons	20 days
4	Design Specification	15 days
5	Progress Report	2 days
6	Expected Aerial System Development	22 days
7	Actual Aerial System Development	41 days
8	Expected Motion System Development	6 days
9	Actual Motion System Development	42 days
10	Expected Client/Server Development	30 days
11	Actual Client/Server Development	50 days
12	Expected UI Development	30 days
13	Actual UI Devlopment	47 days
14	Expected Power System Development	18 days
15	Actual Power System Development	44 days
16	Actual Gyro Development	29 days
17	Expected System Testing/Integration	15 days
18	Actual System Testing/Integration	30 days



Item	Projected Cost ($)	Actual Cost($)	Difference
WI-FI Camera	160.00	94.52	65.48
WI-FI Shield	35.00	99.95	(64.95)
Solar panel	90.00	-	90.00
Servo Motor	60.00	37.13	22.87
Arduino Uno	50.00	38.70	11.30
Weather Balloon	70.00	195.97	(125.97)
Helium Tank	150.00	324.00	(174.00)
Rechargeable Battery	40.00	45.00	(5.00)
Miscellaneous	100.00	179.04	(79.04)
▪ Tarp	---	10.76	
▪ Electronic bedding	---	18.00	
▪ Wood for bracket	---	7.97	
▪ Zap straps	---	8.00	
▪ Circuit components	---	24.80	
▪ Breadboard	---	10.00	
▪ Power Regulator	---	11.50	
▪ Import tax	---	79.96	
▪ Parachute components	---	8.05	
Shipping Cost	120	62.50	57.50
Total	875.00	1076.81	(201.81)
Total + 10% Contingency	962.50	1076.81	(114.31)

Future of SkySeed

- Prototyping: Cost Per SkySeed
- Business Case
- Competition
- Market Delivery
- Product Improvement

Future of SkySeed: Prototyping Cost Per SkySeed

- Total Cost : $344.57
- Market Price : $1000
- Profit : $309.5 per prototype

Item	Cost($)
Wi-Fi Camera	94.52
Circuit Module	46.99
Servo Motor	18.67
Arduino Uno	38.70
Weather Balloon	48.99
Rechargeable Battery	45.00
Circuit components	24.80
Power Regulator	11.50
Employee Royalty	360.00
Total Cost	**690.50**

Business case

- Target Market : North America
- 500 Unit in first year of launch
- 500 Units X $1000 = $500,000 first year’s net revenue
- Of which $154,750 profit
- %100 of profit is re-invested first 5 years of operation

Future of SkySeed: Competition

Company Name	Price ($)	Balloon Volume (m^3)	Main Market
Panalloon Systems	1000	~2.40	• Law Enforcement • Agriculture • Journalism & Film • Research • Oil Industry
Ariel Product Camera & SkyDoc Balloon	4600	~4.5	• Law Enforcement • Military • Film
Lockeed Martin	6.9 M	~12000	• Military/Government
TCOM	10.23 M	N/A	• Military/Government

Panalloon Systems, Design Specification for SkySeed, Simon Fraser University, Burnaby, BC,

Future of SkySeed: Competition

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Panalloon Systems vs. Aerial Products:

Specs	Aerial Products	Panalloon Systems
Price	$4600 (Camera not included)	$2000
Size ~ 2 kg lift	4.5 m^3	2.46 m^3
Stability	High tech Wind Stabilizer	Gyroscope to Stabilize
Material	Vinyl (More durable)	Chloroprene (Less durable)

Aerial Products,January 10th,[Online]KingFisher:http://www.aerialproducts.com/

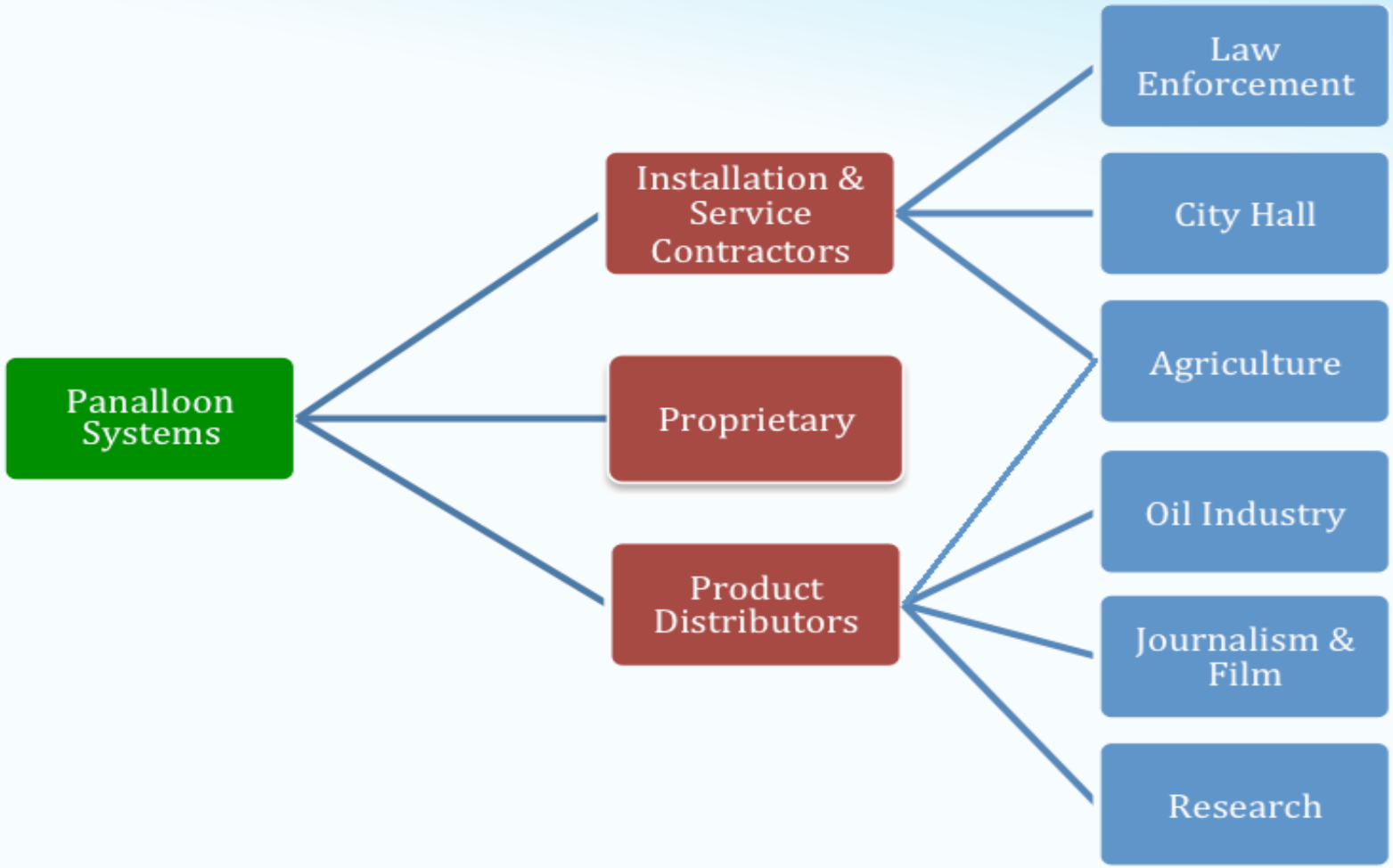
Future of SkySeed: Competition

Aerial Products,January 10th,[Online]KingFisher:http://www.aerialproducts.com/

Future of SkySeed: Product Improvements

- Develop a PID controller to stabilize and user control
- Add UI feature allowing only one user to control camera orientation at a time
- Auto rotate image
- Add system status: wind speed, temperature, battery life, helium level

Future of SkySeed: Market Delivery



Conclusion

- Many more enhancements anticipated for SkySeed, if time and money had permitted
- We learnt about:
  - Communicating efficiently in a team
  - Writing technical documentation
  - Adhering to hard and soft deadlines
  - Developing a Windows Form application
  - Aerodynamics, Wi-Fi, power, wood-working, gyroscopes
- We are proud of our accomplishments and enjoyed the experience

Acknowledgments

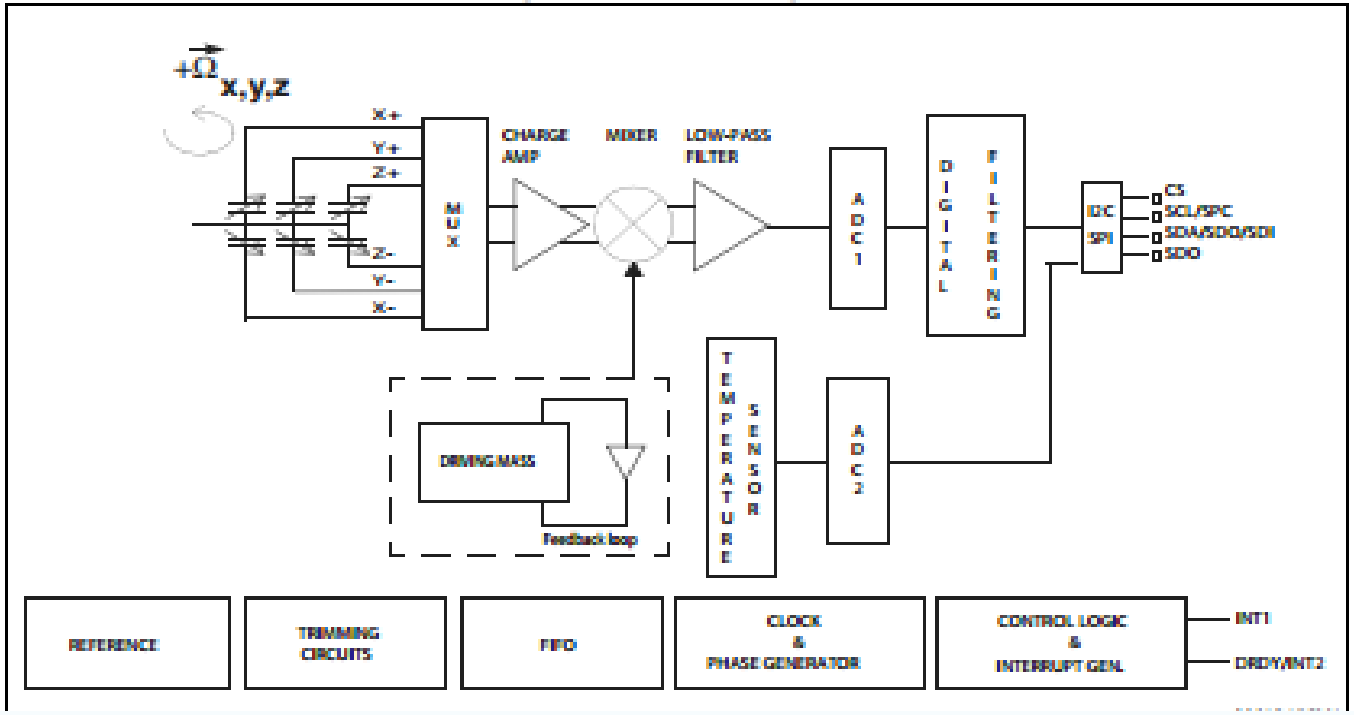
- Dr. Andrew Rawicz and Mr. Steve Whitmore
- Jamal Bahari and respected TAs of ENSC 440
- Fred Heep
- Gary Houghton
- Lucky One
- Clark Hsieh
- Weighton Fund
- ESSEF Endowment
- Campus authority

Questions

Aux Slides

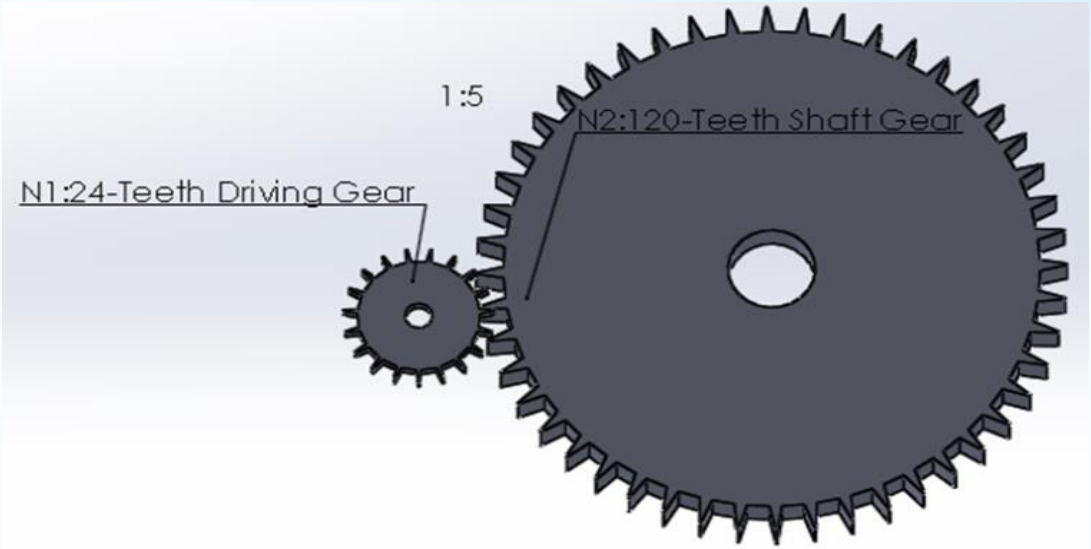
Block diagram and pin description

Figure 1. Block diagram



Aux Slides

- Provide rotational resolution
- And torque reduction



Aux Slides

	Task Name	Duration	Start	Finish
1	Project Proposal	9 days	Wed 08/01/14	Mon 20/01/14
2	Research	57 days	Wed 04/12/13	Thu 20/02/14
3	Functional Specificatikons	20 days	Tue 21/01/14	Mon 17/02/14
4	Design Specification	15 days	Sat 22/02/14	Thu 13/03/14
5	Progress Report	2 days	Sat 22/03/14	Mon 24/03/14
6	Expected Aerial System Development	22 days	Tue 04/02/14	Wed 05/03/14
7	Actual Aerial System Development	41 days	Wed 05/02/14	Wed 02/04/14
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9	Actual Motion System Development	42 days	Mon 17/02/14	Tue 15/04/14
10	Expected Client/Server Development	30 days	Mon 03/02/14	Fri 14/03/14
11	Actual Client/Server Development	50 days	Mon 03/02/14	Fri 11/04/14
12	Expected UI Development	30 days	Mon 03/02/14	Fri 14/03/14
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17	Expected System Testing/Integration	15 days	Wed 12/03/14	Tue 01/04/14
18	Actual System Testing/Integration	30 days	Wed 05/03/14	Tue 15/04/14