Helium Micro Air Vehicle (MAV)

Problem Definition and Project Plan

Fawaz Alenezi, Hamoud Alkhaldi, Abdulrahman Almuqhawi, Matthew Kohr,
Conrad Nazario and Randal Spencer

September 21, 2015

Overview

- Introduction
- Goal Statement
- Objectives
- Constraints
- State of the Art Research
- Project Management
  - Quality Functional Deployment
  - Project Plan
- Conclusions

Introduction

- Client is Dr. Srinivas Kosaraju
- Generate a product that can compete with other commercial products
- The ability to generate a product by March 15, 2016

Goal Statement

- The goal is to develop a Micro Air Vehicle that can ascend, descend, and survey areas more efficiently then drone and quadcopters while using helium as its main source of lift.

- Our team goal is also to limit energy consumption so that the Helium MAV will last longer and stay operational longer then other MAV’s.

Objectives

Objective	Measurement	Units
Limit Weight/Payload	Mass	kg
Optimize Response Time	Time	Seconds
Minimize Cost	Currency	$
Double distance of standard quadcopters	Length	m
Durable	Time	Seconds
Easy to Store	Volume	m^3

Constraints

- Max size $1.8 \text{ X } 0.91 \text{ X } 0.91\ m^3$
- Reach a minimum height of 30.5 m
- $2000 budget
- Must have mounted cameras with a live feed
- Remote controlled guidance system
- Temperature and weather sensors
- Must move forward, backwards, ascend and descend and hover at a specified altitude

Helium vs Hydrogen

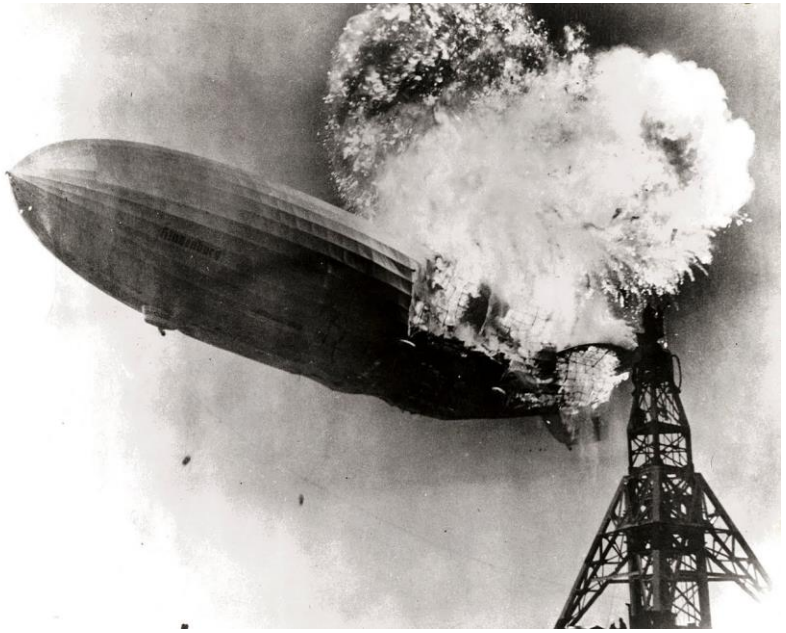
Advantages

- Inert gas and is nonflammable
- 7 times lighter than air
- Lifts around 0.96 $\mathrm{kg/m^3}$
- Hydrogen ($\mathrm{H_2}$) is highly flammable

Disadvantages

- More expensive than hydrogen
- Weighs twice as much as hydrogen
- Hydrogen can lift about 8-11% more

Hindenburg Disaster



Source: Wikipedia.org

State of the Art Research (SOTA)

Airlander 1

Source: **.hybridairvehicles.com**

- Altitude 6096 m
- Payload capacity of 10,000 kg
- 5 days of flight time

Air Penguin

Source: **festo.com**

- 1 m^3= 1 kg buoyant force
- Length 3.7 m
- Aluminium-Metallised Foil, 22 $\mathrm{g/m}$
- Li-Polymer battery, 2000 mAh, $4.2\ \mathrm{V}$
- Ultrasound Receiver Capsules

SOTA Continued

HERO4 SILVER

Source: gopro.com

- $399.99 USD
- Estimated time usage:1hr 35mins
- Weight 74 g
- 4K HD
- 12 Megapixel Sensor
- Night Vision / Waterproof

dji PHANTOM

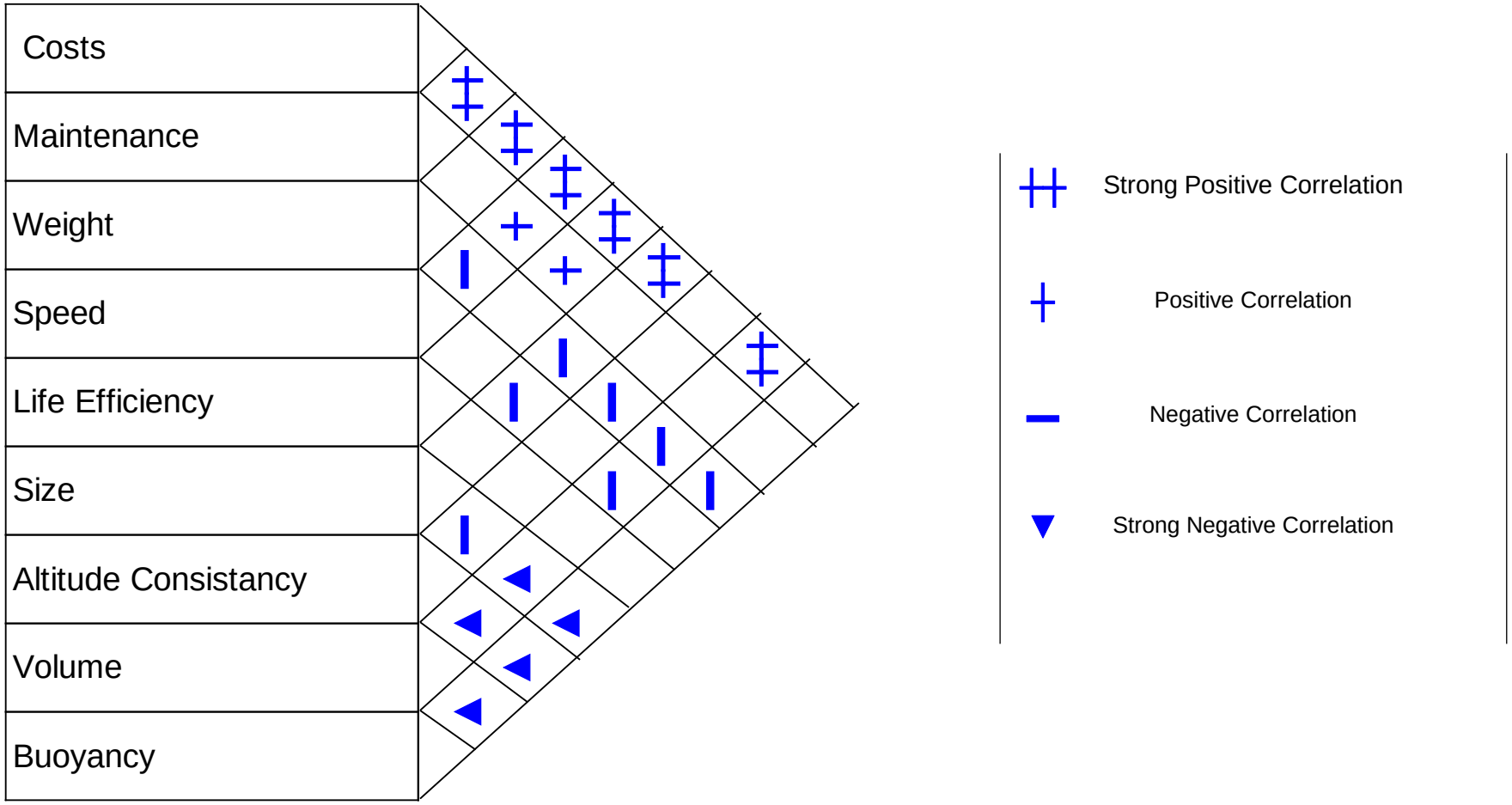
Source: http://www.dji.com/products/

- Phantom 3 Quadcopter
- $1290.00 USD
- Flight time: 30 mins (max charge)
- Weight 1280 g
- Max Flight Speed: 16 m/s

Quality Functional Deployment

Legend			Quality Characteristics (a.k.a. "Engineering Requirements") / Demanded Quality (a.k.a. "Costumer Requirements")	Costs	Maintenance	Weight	Speed	Life Efficiency	Size	Altitude Consistency	Volume	Buoyancy
Θ	Strong Relationship	9	Effectiveness of flight	O		Θ	Θ		Θ	O	O	Θ
O	Moderate Relationship	3	Durability	Θ	O			Θ	O	▲		
▲	Weak Relationship	1	Storage	O	▲	O			Θ		Θ	
			Distance	O		Θ	Θ		Θ	O	O	O
			Manufacture	Θ	▲	▲	▲	O	O		O	O
			Camera	Θ	▲	O		▲	O		O	Θ
			Maintenance	O	O				O			
			Cost	Θ	Θ	Θ	Θ	Θ	Θ		Θ	Θ
			User friendly	O	O							
			Shelf parts	Θ	O	O	O	Θ	O		O	O
			Weather Sensors	Θ	Θ	Θ		O	O		O	O

House of Quality



Project Plan

Task	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Communicate With Client															
Defining Project ,Need, Goal, Objective and Constraints															
Preparing Quality Function Deployment:															
State Of the Art Research															
Creating Function Diagram:															
Conceptualizing Alternative Approach															
Applying Decision Matrices															
Concept Selection															
Engineering Analysis															
Material Selection															
Fabricating Concept Prototype															
Testing Concept Prototype															
Preparing Budget Analysis															
Finalizing The Project															
Problem Definition and Project Planning			◆												
Concept Generation and Selection								◇							
Concept Prototype												◇			
Project Proposal															◇

◆ Finished milestone

◇ Unfinished milestone

Conclusion

- Client Dr. Srinivas Kosaraju needs a way to capture images above known areas of contamination
- Our mission statement is to optimize the operation and endurance potential of the aircraft while minimizing response time using inert gas Helium
- Objectives including minimizing cost, optimizing communication and flight duration will determine many aspects of production
- Cost must be under budget of $2000

References

1) Festo AG &Co. *AirPenguin*. Osfildem, Germany 73760. **http://www.festo.com/rep/en_corp/assets/pdf/airpenguin_en.pdf**

2) Hybrid Air Vehicles. *Airlander*. Bedford, UK MK42 OTG. **http://www.hybridairvehicles.com/downloads/Airlander-21.pdf**

3) Trancossi, Michele Trancossi, Mauro Madonia, and Antonio Dumas. *HYDROGEN AIRSHIPS: A NECESSARY RETURN BECAUSE OF HIGH COSTSOFHELIUM*. Tech. no. 10.4271/2012-01-1512. Academia, 9 Nov. 2012. Web. 25 Sept. 2015

4) Go-Pro inc. *Hero 4*. Copyright United States. **http://shop.gopro.com/cameras/hero/CHDHA-301.html?skipredirect&gclid=CP2c8ciugcgCFUdffgodwr8P3Q**

5) Brain, Marshall. "How Helium Balloons Work" 01 April 2000, HowStuffWorks.com. <http://science.howstuffworks.com/helium.htm> 18 September 2015