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# Searcue Team

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# Motivation


- Save lives
- Reduces human error
- Reduces search and rescue operation costs

# Search and Rescue


- Every year people are lost in places such as mountains and forests
- The cost of using regular helicopters for search and rescue is around $1800 per hour
- Mission stops at sunset

# Market


- Various Applications
  - Security & Surveillance
  - Delivery
  - Military
  - Photography

- "Airware" raised more than $40 million in venture capital funding.

# The Searcue System:


- The use of Unmanned Aerial Vehicles for search and rescue operations

- Components of the Searcue System
  - The UAV
  - Person Identification Server (Image Processing)
  - Alert system for Users/Search and Rescue team

# System Overview

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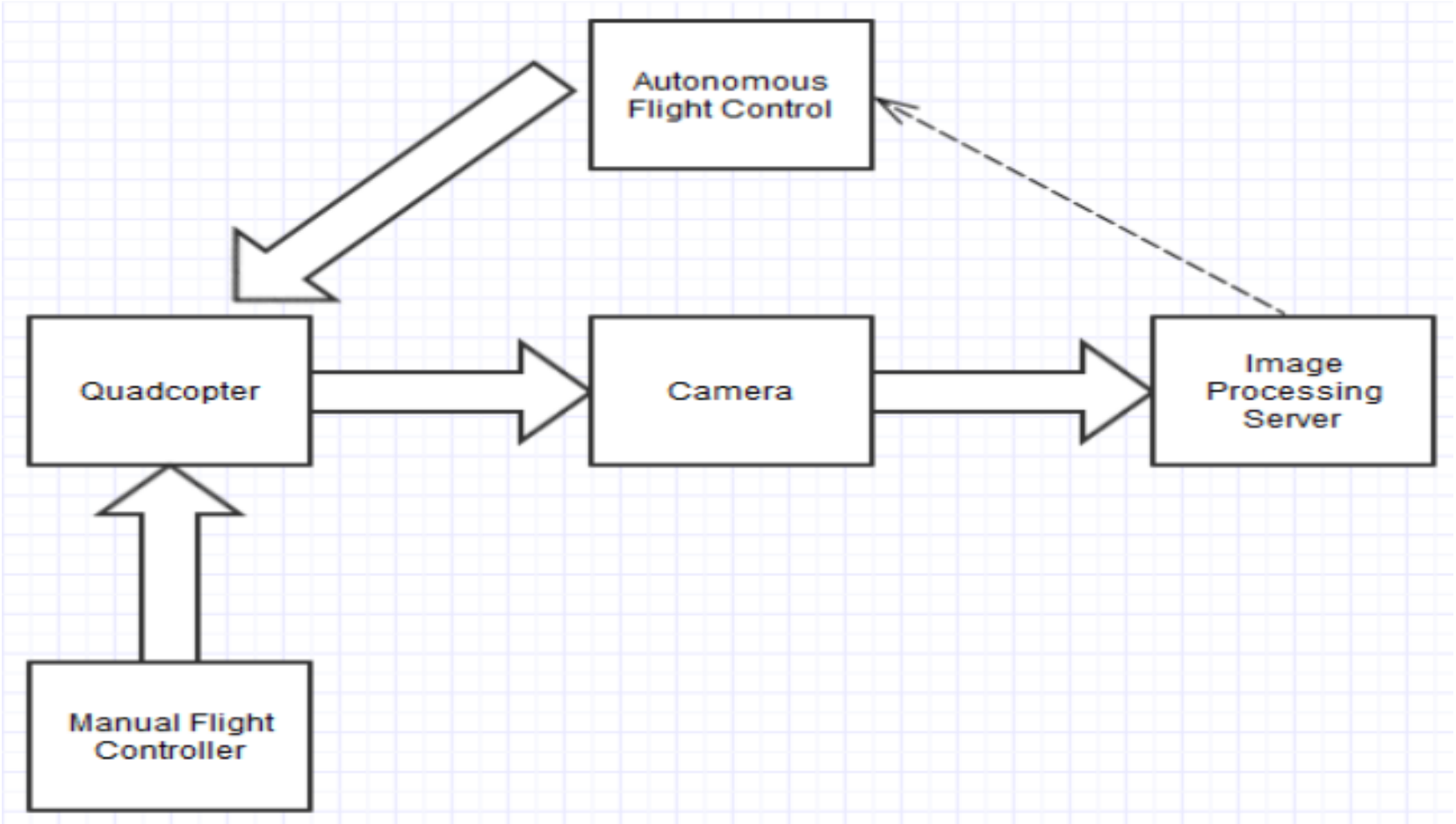

# UAV – Why Quadcopter?


- Full mobility – 6 degrees
- Ability to investigate various terrain with low risk to humans
- Can hover allowing for wide array of manoeuvres
- Flight controller allows for stability during flight making close interaction safe

# Working Principle

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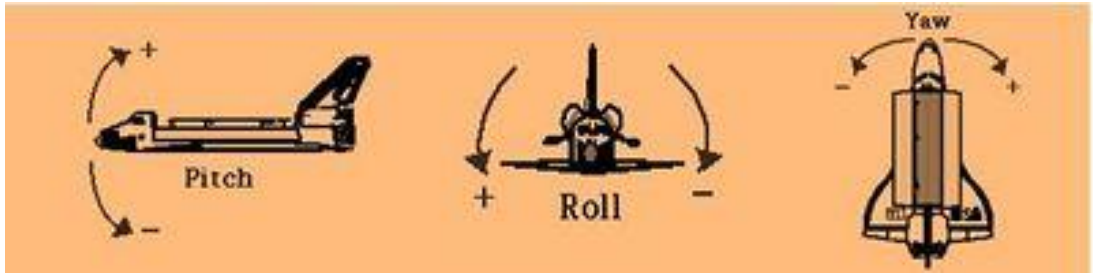
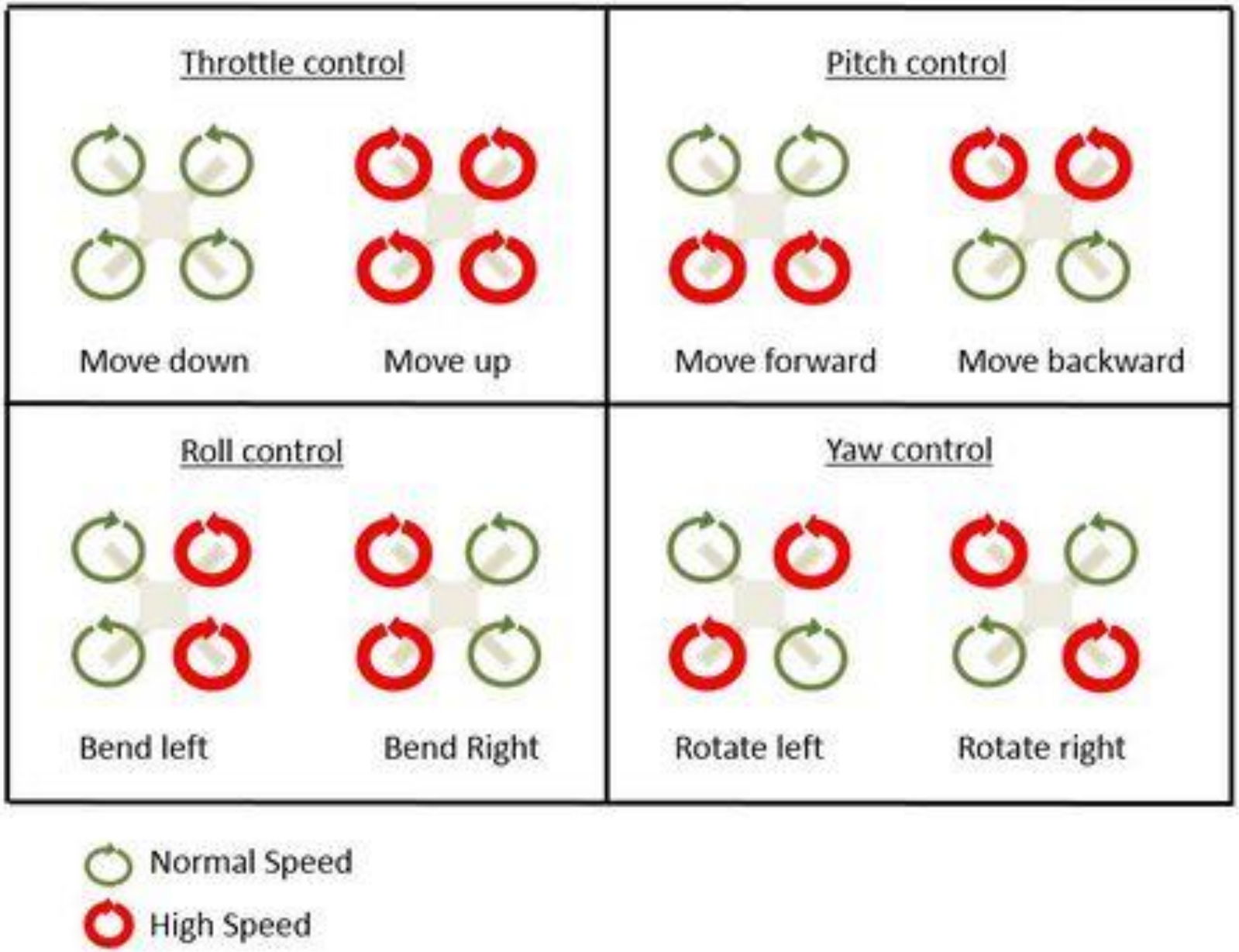
- A quadcopter is an unmanned aerial vehicle (UAV) which incorporates a mixture of electronics and mechanics
- A quadcopter has four motors whose speed and direction of rotation correspond to movement in a particular direction (throttle, pitch, roll and yaw)




Throttle control
Move down
Move up
Pitch control
Move forward
Move backward
Roll control
Bend left
Bend Right
Yaw control
Rotate left
Rotate right
Normal Speed
High Speed

# System Overview: UAV

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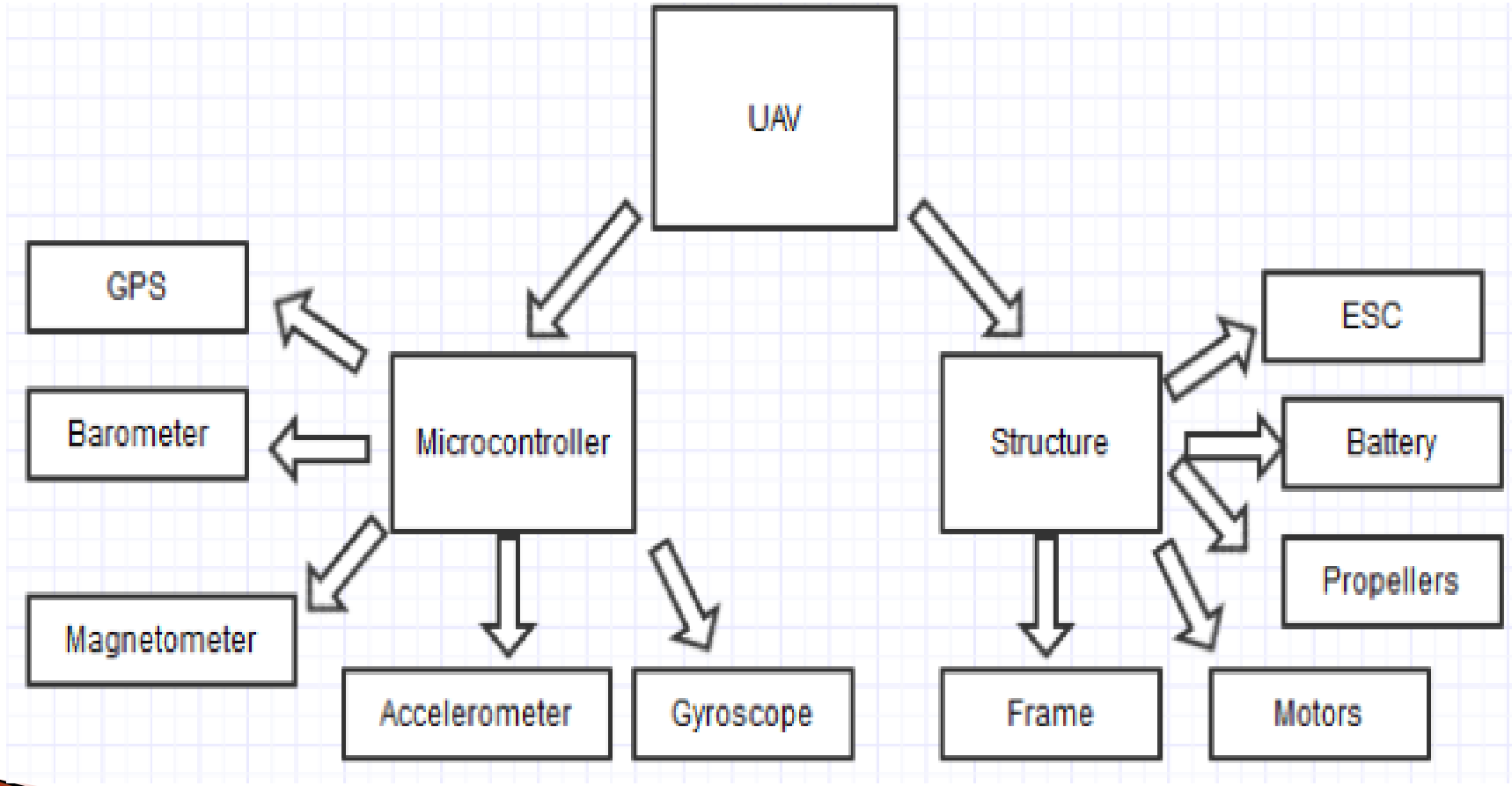

# Basic Materials Required


- Arduino microcontroller
- Brushless Motors – 920kV
- Transmitter and Receiver
- Electronic Speed Controllers (ESC)
- Propellers
- Frame
- Sensors – gyroscope, accelerometer, magnetometer and barometer
- Battery

# Microcontroller – Flight Control

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- Arduino based
  - Inertial Measurement Unit
  - Barometer
  - GPS
- Alternatives
  - Various hobby flight controllers (Hobbyking.com)
  - Raspberry Pi

# Circuitry

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- Power Distribution
- Electric Speed Controllers
- Motors

# Structure/Physics

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- Frame
- Thrust
- Weight
- Flight time

# Transmitter/Receiver

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- Manual Control of Quadcopter

# Quadcopter Review


- Chosen due to versatile nature
  - Other drones cannot hold altitude while offering the same maneuverability
- Arduino based flight controller
  - Offers real time kernel (RPi does not)
  - Most flight controller software is based on arduino

# Camera – Video Transfer


- Raspberry pi
  - Camera module
  - Linux based tools/development tools
  - gstreamer
- Alternatives
  - Go pro
  - USB/IP cameras

# Image Processing Server


- Server side computation
  - Heavy CPU load requires server side computing
  - Sends email notifications

# Software

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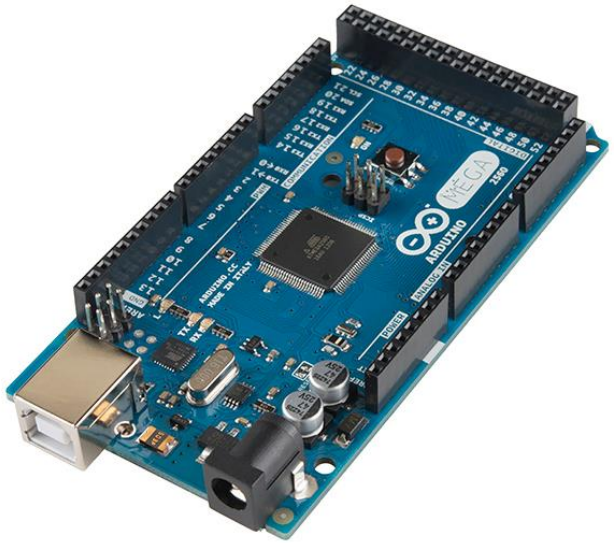
- Microcontroller
  - AeroQuad Software
    - Cheapest and most efficient
- Alternatives
  - openPilot
  - Ardupilot
  - Wii Sensor boards



# Raspberry Pi – Camera

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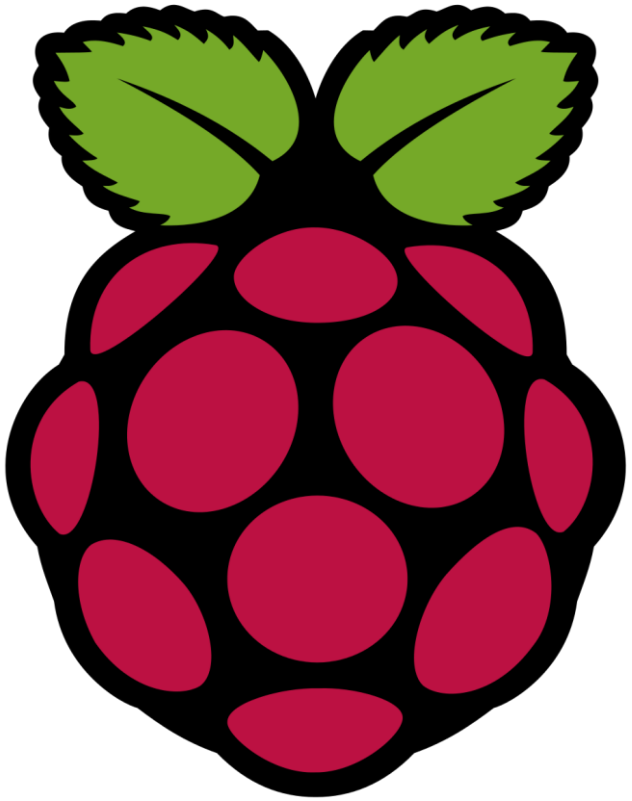
- Raspberry Pi
  - Gstreamer
  - SSH
  - Cheap HD camera
  - Efficient



# Server


- Server
  - High CPU needs for image processing HD video
  - OpenCV
  - NGINX
  - POCO
  - HTML

# Searcue Server/Website


- Standalone application (OP)
  - Image processing
- Web-based application
  - Rtmp protocol for live streaming
  - Client side – html javascript
  - Server side – php
  - Overall Design Formatting – CSS

| Component | Predicted Cost($) | Actual Cost($) | Difference($) |
|---|---|---|---|
| Turnigy 9ch Transmitter and 8ch Receiver | 75 | 90 | 15 |
| GPS Shield Kit | 75 | 75 | 0 |
| Raspberry Pi, WIFI dongle and Pi camera | 65 | 100 | 35 |
| 4x DJI 920KV Brushless Motors | 50 | 50 | 0 |
| 4x Electronic Speed Controllers | 50 | 80 | 30 |
| 9DOF Sensor Stick | 50 | 50 | 0 |
| Cable Connectors, spacers and wires | 50 | 50 | 0 |
| Zippy 4000mAh Battery | 30 | 30 | 0 |
| Carbon Fiber Frame | 30 | 30 | 0 |
| AeroQuad Shield | 30 | 30 | 0 |
| Power supply / distribution board | 30 | 30 | 0 |
| Carbon Fiber Propellers | 20 | 20 | 0 |
| Barometer BMP180 | 15 | 15 | 0 |
| Battery Charger | 0 | 70 | 70 |
| Subtotal | 570 | 720 | 150 |
| Shipping and Duty | 60 | 100 | 40 |
| Total | **630** | **820** | 190 |

# Market

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- Competitors such as the DJI Phantom retail for about 800 dollars
- Most other Quadcopters retail for that range

# Timeline

| Actual | Expected | Project Timeline |
|---|---|---|
| Sep 13 | Sep 13 | Research |
| Sep 20 | Sep 20 | Functional Specification |
| Oct 12 | Oct 12 | Design Specifications |
| Dec 12 | Sep20 | Ordering/ Buying parts |
| Dec 15 | Dec 7 | Documentation/ Website |
| Nov 16 | Nov 16 | Process Report |
| Nov 5 | Oct 26 | Flight and Flight controller |
| Oct 20 | Oct 12 | Prototyping Flight and Flight controller |
| Nov 10 | Oct 26 | Debugging the flight and flight Controller Prototype |
| Dec15 | Nov 23 | Image processing and Automation |
| Nov 25 | Nov 9 | Integration image processing into the Quadcopter |
| Dec 10 | Nov 23 | Debugging the final prototype |

# Searcue Summary


- Quadcopter
- Camera
- Server
  - Web application
  - Image Processing
  - Email notification

# Future of Searcue: Product Improvements


- Develop better algorithms for search and rescue
- Implement better cameras – thermal
- More refined software package
- Real-time image processing
- Autonomous flight using waypoint

# Future of Searcue – Other Applications


- Security
- Photography
- Geographical Surveys

# Challenges


- Receiver
- 9DOF voltages
- ESC calibration
- RTMP Server
- Wifi/LAN

# Conclusion


- We expect future endeavours for Searcue by enhancing our product
- We learned
  - Communicate and work efficiently in a team
  - Writing technical documents
  - Aerodynamics, sensors, microcontrollers, communication protocols, and various image processing techniques
- This was a valuable experience and we are proud of our accomplishments

# Acknowledgements



- Dr. Andrew Rawicz and Steve Whitmore
- Jamal Bahari, Lukas Merhi and Mona Rahbar
- Fred Heep
- Craig Scratchley
- George Xu
- Daman Dhillon
- Mohammad Kavin
- ESSEF Endowment

# Questions?

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