UAV Assisted Energy Delivery

Team: sdmay19-43

Website: http://sdmay19-43.sd.ece.iastate.edu/

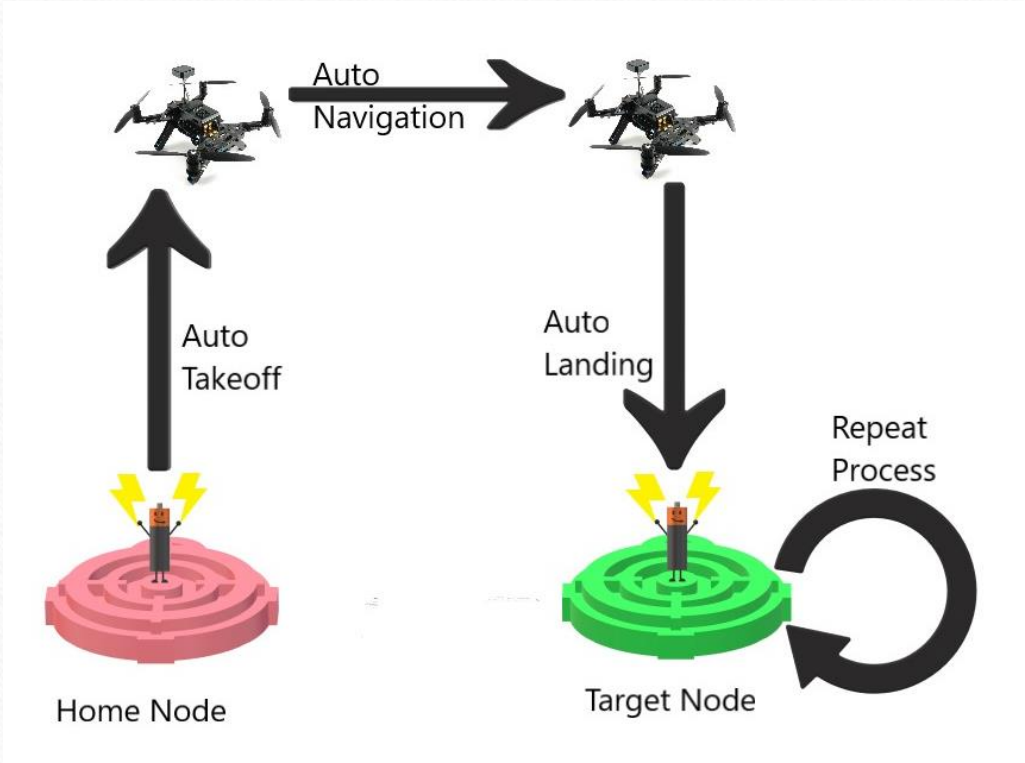
Advisors and Clients: Drs. Randall Geiger & Degang Chen

Problem Statement

- Many Devices, Few Connections
- Difficulty to add new systems to existing ones
- Flexibly Energy Delivery Through Drones

Intel Drone: https://docs.px4.io/en/flight_controller/intel_aero.html

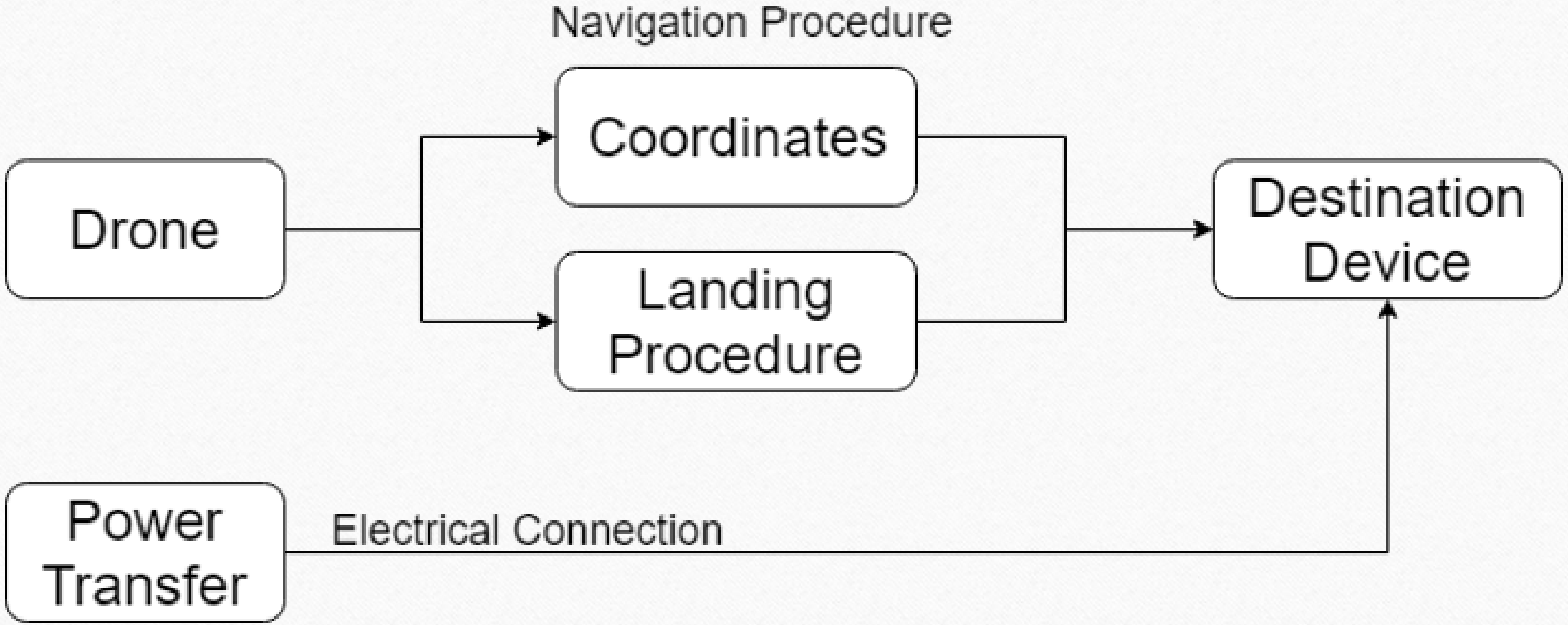
Solution



UPS: https://teamster.org/news/2018/07/teamsters-release-ups-national-agreement-principle-highlights

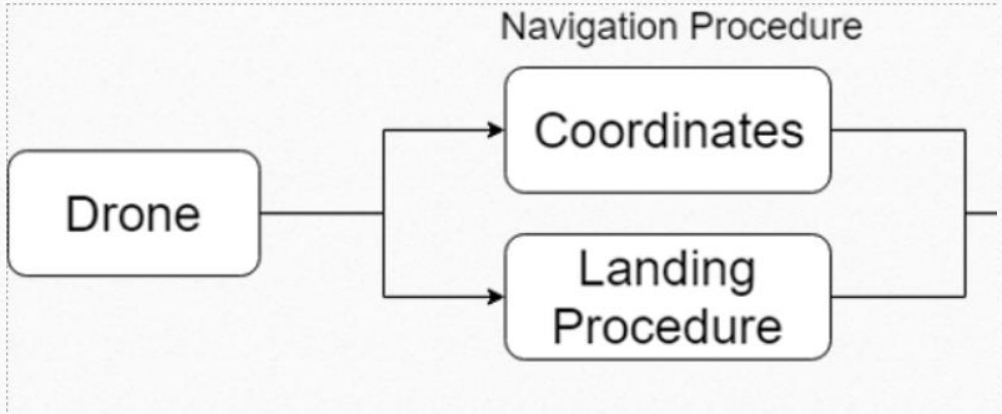
Functional and Non-Functional Requirements

- Functional
  - Take off and fly to and from a specified location autonomously
  - Dock with landing station for power transfer autonomously
  - Deliver power to and from payload battery to landing station
- Non-Functional
  - Security
  - Scaling system to miles
  - Multiple drones, bases, nodes


Navigation Procedure
Drone
Coordinates
Landing Procedure
Destination Device
Power Transfer
Electrical Connection

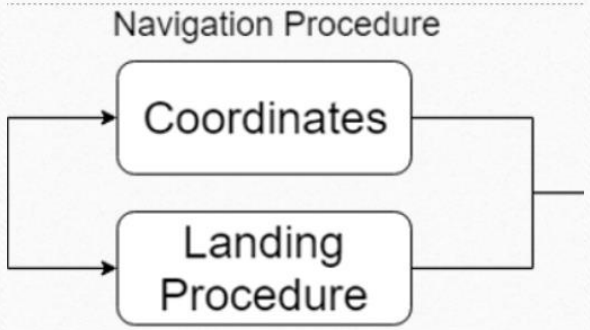
System Design

- Automated Flying
  - Using existing drone (Intel Ready-to-Fly)
  - Receive coordinates to landing station
  - Flys autonomously at an efficient speed at variable distances



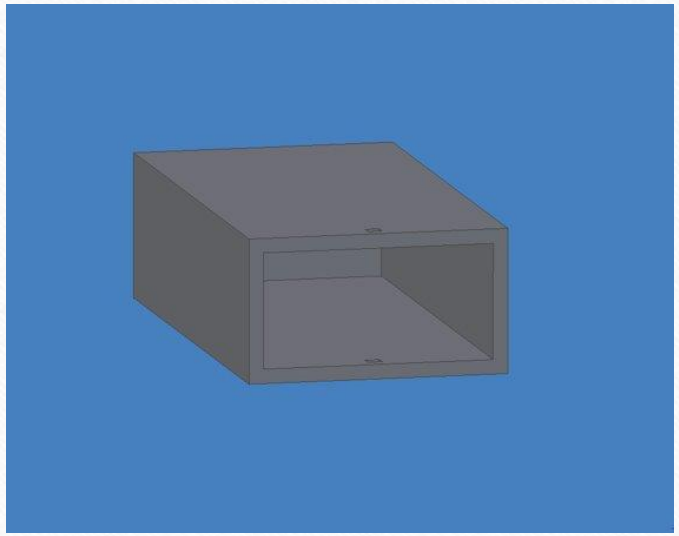
System Design

- Automated Landing Procedure
  - Unique landing station
  - Controlled descent to prevent crashing
  - Fine movement to land



System Design

- Energy Transfer
  - Use separate payload battery to transfer energy
  - Carriage design for payload battery transport
  - Attach and detach without human assistance



Project Management

- Group Members focus:
  - Alexandra & Garth
    - Drone Troubleshoot & Fly to location
  - Brendan & Kevin
    - Landing Station design & Power transfer method
  - Connor & Kaitlyn
    - Precision movement & Image detection

Operating Environment

- Overall system will deal with:
  - Adverse weather conditions
  - Objects to avoid
  - Regulatory areas
- Our scope will deal with:
  - Clear day
  - Open field
  - Outside of regulatory areas (FAA restrictions)

Constraints

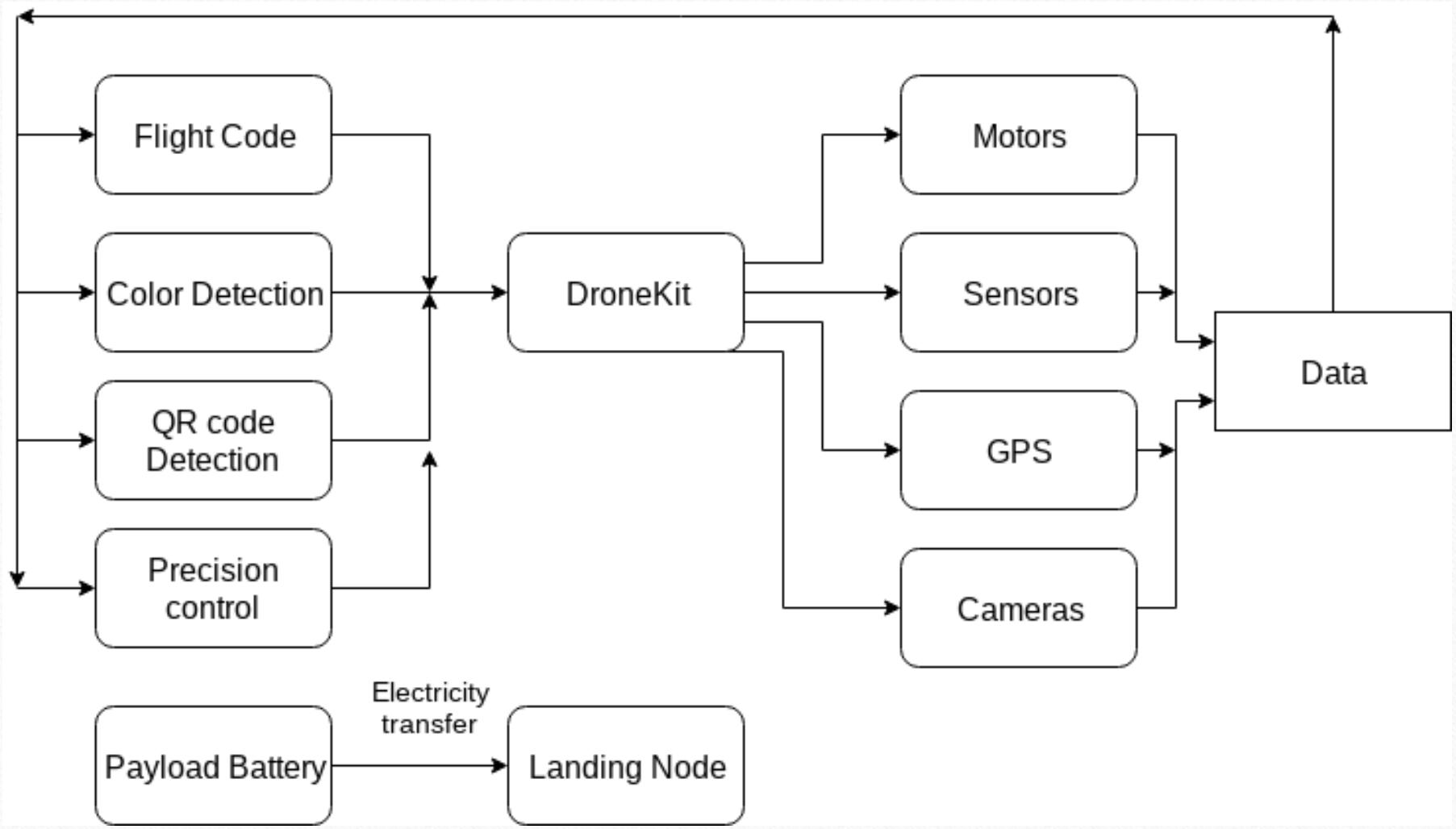
- Battery Capacity (Drone power source)
- Testing Safety
- Drone Carrying Capacity

Detailed System Design

- Autonomous flying
  - GPS or Cardinal coordinates
  - Use DroneKit for high level design
  - Use Intel Drone due to open source

- Automated landing
  - Image processing

    (Color & QR detection)
  - Small precise movements
- Power transfer
  - Magnetic cord will be easy to attach and detach
  - 3D printing custom carriage design allows lightweight solution


Flight Code
Color Detection
QR code Detection
Precision control
DroneKit
Motors
Sensors
GPS
Cameras
Data
Payload Battery
Electricity transfer
Landing Node

Implementation

- Hardware
  - Intel Ready-to-fly drone
  - Lithium polymer battery
  - Payload Battery (Lithium Ion)
  - Landing Station
- Software
  - DroneKit
  - OpenCV & Pyboof

Standards

- 1028-2008 Software Audits
- 1625-2008 Multicell Batteries
- 16085-2006 Risk Management
- 14764-2004 Software Lifecycle Process and Maintenance

Testing Plan

- Unit testing
  - Fly to location
  - Landing
  - Energy Transfer
- Integration
  - Put all components together

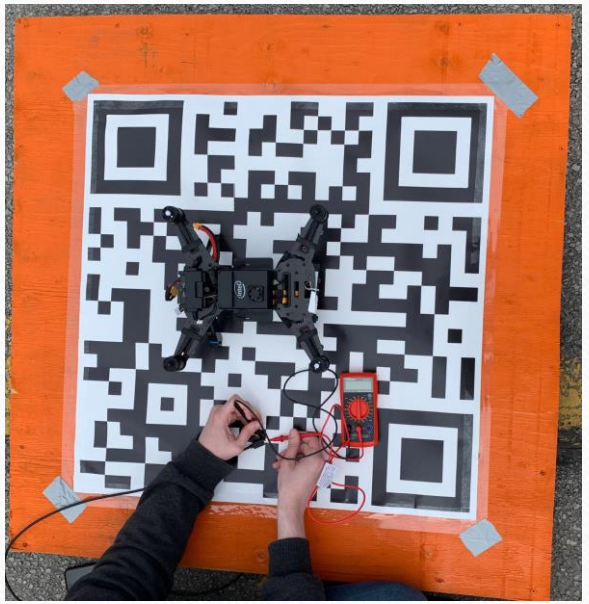


Image Detection Video

- Image Detection

Conclusion

- End Product
  - Components completed
    - Landing station, reliable energy transfer, color detection, precision control, QR code detection, fly to GPS & cardinal coordinates
  - Integration unsuccessful

Acknowledgements

- Dr. Geiger and Dr. Chen
- Dr. Zambreno
- Jeffery Richardson
- Jacques Arnoult

Sources

- Intel drone

https://docs.px4.io/en/flight_controller/intel_aero.html

- UPS guy

https://teamster.org/news/2018/07/teamsters-release-ups-national-agreement-principle-highlights

Questions?