Advanced Mechatronics: AR Parrot Drone Control Mini Project #1

Engineering Team Members:

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Advanced Mechatronics: Project Background

- AR Drone is an excellent platform to help people with disabilities explore a world they wouldn't otherwise see
  - Stroke, ALS, Spinal Cord Injury, Cerebral Palsy
  - Age-related disabilities
  - Other disabilities that leave people immobile or bedridden
- AR Drone was designed for many other reasons in mind as well:
  - Military applications
  - Hobbyist purposes
  - Remote surveillance
- Because of this, there is a need to adapt control systems so that those with physical disabilities have easier control of the drone through a more user-centered design
- Example: The drone battery only lasts ~10 minutes: How can you get up to charge the drone if your limbs are nearly immobile?

Current Platform

Computer GUI and Oculus Rift: (FF to 4:37)
http://www.ted.com/talks/henry_evans_and_chad_jenkins_meet_the_robots_for_humanity?language=en#t-265535
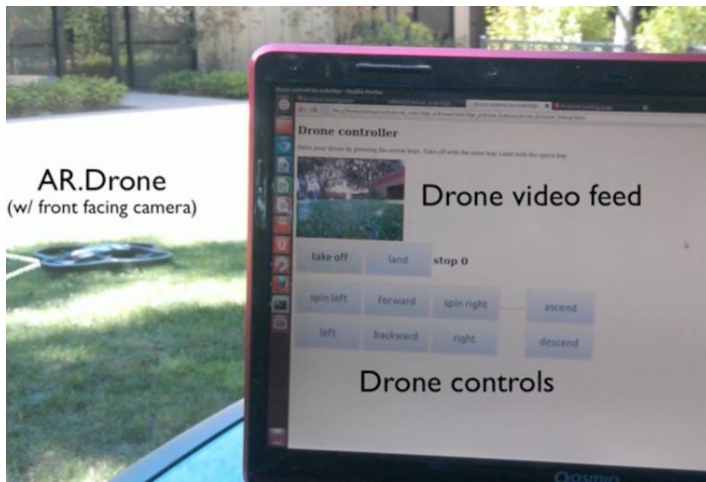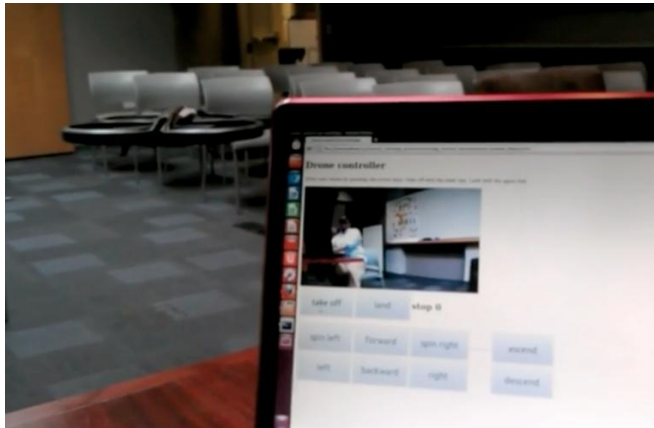
Advanced Mechatronics: Project Plan

Phase 1: Design Testing Platform

Phase 2: Automated Landing Sequence

Phase 3: Battery Charging Station

Testing Platform Design-1

- To construct automated landing sequence and battery charging station, a more user-friendly control is necessary.
- Although final system will work with Oculus Rift and computer GUI, we need something easier to control for our testing.
- Drawbacks of Oculus Rift include:
  - You can't physically see the drone - only virtually
- Drawbacks of computer GUI include:
  - Control is difficult with mouse or keyboard click
  - It is difficult to carry computer as you walk around inspecting and testing further design
- Drawbacks of USB Joystick (easy off the shelf method) include:
  - Same problem as computer GUI - it is not wireless
- Drawbacks of i-Phone app (another easy control method) include:
  - Can only control with accelerometer in x and z directions
  - Other functions such as yaw, y-direction motion, and landing require pressing tiny touch buttons

Testing Platform Design-2

- Testing platform requirements:
  - Tactile feel of control buttons
  - Tactile feel of control speeds through joystick potentiometers
  - Numerical data feedback of control velocity commands
  - Wireless operation of controller -- so it can be carried around easily as you walk around testing further systems
  - Reliable wi-fi system with good response time

AR Drone System Schematic

Wi-Fi

Back/Forth

Up/Down

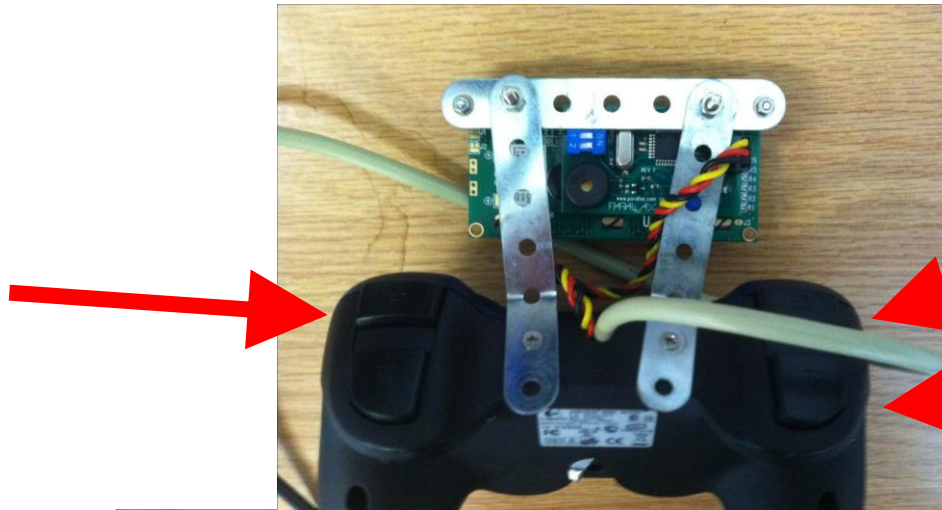Right/Left

Yaw (Left)

Yaw (Right)

Takeoff/Land

9v
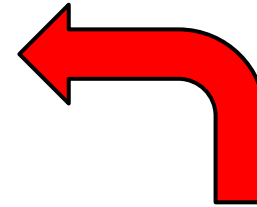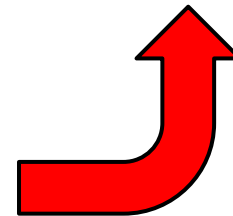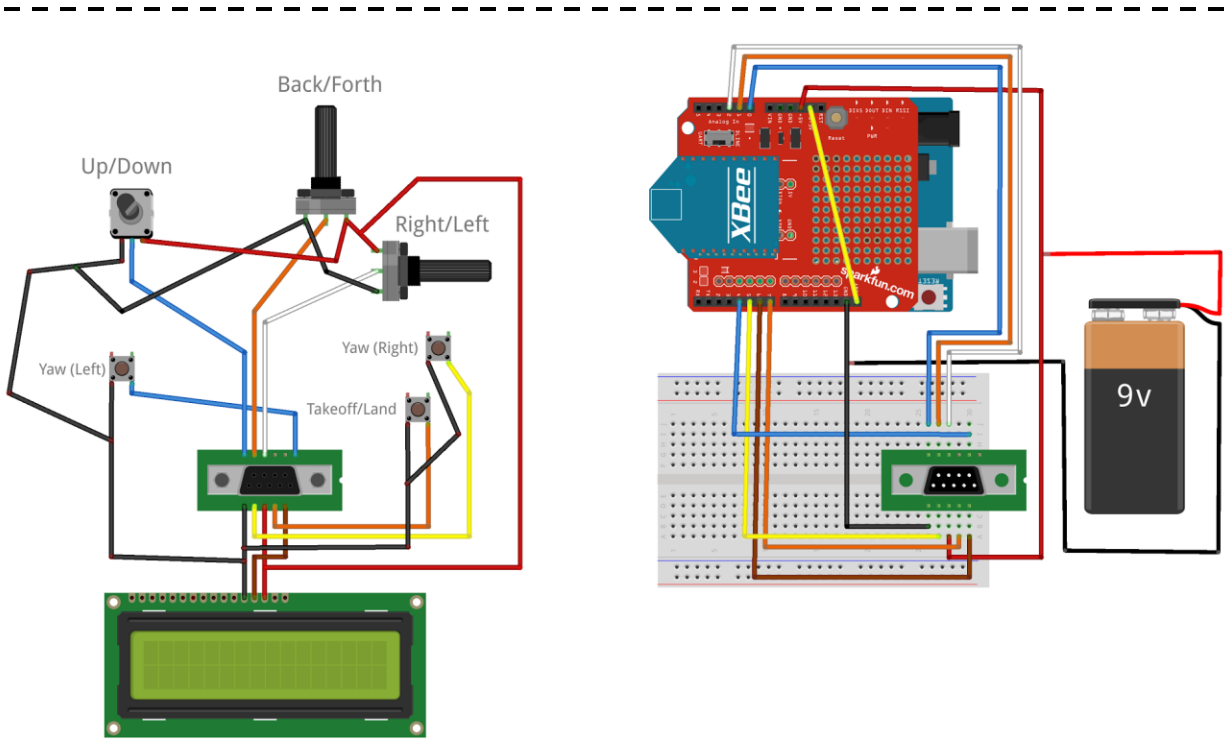
RF

Mechatronics Features-1

- Parallax Digital LCD controlled through digital output signal
  - Mounted on joystick for easy visual reference
- 3 buttons on customized joystick used for control of:
  - Takeoff and Landing
  - Yaw movement (rotation about the y, or up/down axis)
- 3 analog pins used for velocity in x,y,z directions
  - Joystick knobs only move through ½ of a 270 degree pot: thus, 3.3V is used as an analog reference for resolution recovery. With this we are able to utilize about ¾ of the 10 bit resolution.
- XBee RF system: serial signals sent between Arduino computer processing system through pins 2&3
- 9-pin D-Sub connector to link Arduino to joystick
- 9-V battery to power wireless mechatronic system
- Computer receives RF serial signal through Processing software - language is the same as Arduino but it can interface to Wi-Fi through our programming architecture
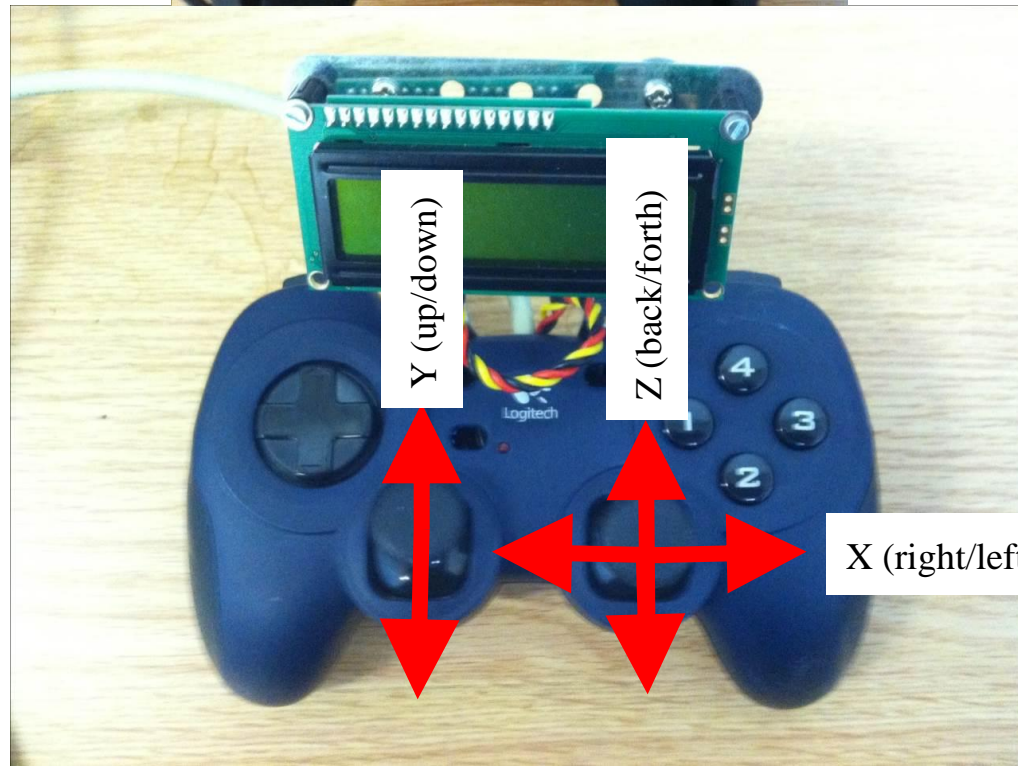- Computer communicates control to AR Drone through Wi-Fi

Mechatronics Features-2

Yaw Left

Takeoff/ Landing

Yaw Right

Y (up/down)

Z (back/forth)

X (right/left)

Mechatronics Features-3

Bill of Materials

Sl. No.	Component	Price per piece	Quantity	Total Price
1.	Arduino UNO	$26.57	1	$26.57
2.	Serial LCD Display	$29.99	1	$29.99
3.	XBee Explorer Regulated	$17.95	2	$35.80
4.	SparkFun XBee Shield	$14.95	1	$14.95
5.	Joystick	$8.45	1	$8.45
6.	Experiment breadboard	$5.88	1	$5.88
7.	DB9 RS232 Serial Cable	$3.49	1	$3.49
8.	USB cable	$4.67	1	$4.67
9.	9 Volt battery	$2.99	1	$2.99
10.	Parrot AR drone Quadricopter	$0.00	1	$0.00
	TOTAL PRICE			*$132.79*

Team Roles

- Ashwin:
  - Sensor mapping and integration with Processing
  - Calibration of AR Drone

- Feng:
  - WiFi control
  - Coding

- Henry:
  - X-Bee configuration
  - Hardware integration

Results-1

- We have developed a device that controls the AR-Drone through arduino connected to XBee communicating to the computer
- A comparison was made between the XBee serial communication and USB serial communication, it was found that serial communication through XBee had an extra delay of 30 milliseconds compared to USB serial
- Careful and efficient coding was attributed to minimize delay in response time in the drone
- Everything works!!!

Results-2