Slide prelude two

Like most kids growing up, I had a bike and would ride around the neighborhood and occasionally on the Rock Creek Bike path with my family. It was during my third year of college, I got serious about riding a bike. I lived off campus and that was my means of transportation to get to and from my classes. I paid $20 for a used bicycle and it worked just fine and I was really enjoying it.

For a graduation present, my parents gifted me with a new Trek 1220 bike. At this time, I also had a car but I preferred riding my bike almost everywhere I went. And many of our family vacations were in places where I could ride my bicycle and we all could hike.

Slide Justification Why Todd is Presenting

Here is screen shot of an article that describes how I got my brain injury. As a result of the injury, I was in a coma for over a week. Please note, I lived in Ohio and I am cyclist. When the article was written in 2014, I had accumulated over 6000 miles of outdoor riding that year.

Slide Presentation Background

Again, I am a cyclist. Here is a picture of me after, four years before my brain injury, as a cyclist, our relay team won the Vermillion Harbor Olympic Triathlon. I also completed a 200 km ride around Lake Constance while I worked in Switzerland in 2006. Lake Constance is a lake between Germany, Austria, and Switzerland.

Slide How Todd Got Involved in Aviation

Uncle Steve got me involved in aviation by taking me to the FLY-IN in Oshkosh, Wisconsin when I was middle school. I became a member of the Experimental Aircraft Association.

Later, before my brain injury, my Uncle Steve began building a Piper Cub from plans.

Slide More of Todd’s Aviation Background

Uncle Steve was building an airplane and I was an avid cyclist living in northeast Ohio. I knew it was not unheard of to operate a home built aircraft without even a single pilot’s lesson. Ask me to cite one example! So, I thought I should at least know something about operating a Piper Cub and I used FlightGear for that.

The NE Ohio winter was too cold for outdoor cycling and I had a bike trainer to stay in shape during the winter.

Why not combine the two? And I did.

At that time, I used a data acquisition device to translate the speed of the bike on a trainer into a joystick throttle position. Trainer resistance is not constant, it varies as the trainer heats up. At first, I compared my speed to a record of a previous exertion on the trainer. Now I use a better method, I think, for this translation.

Slide FlightGear

This configuration worked for me; but no one else knew about my quirk.

When I started to live with my parents, I sought to revive playing flightgear and riding a bike simultaneously

Virtual flights generated physical and mental challenges for me.

On this slide there is a link so you can freely downloadable FlightGear.

Slide Throttle Axis

When I moved back home, I wanted to revive my hobby. One of the first things I did after getting back on the bike trainer was purchase a logitech flightstick and riding in front of a big screen. Here is a Logitech flight stick, commercially available. The throttle axis is here.

Slide Todd’s Bike on a Trainer

Merely exerting myself wth a flightstick myself was still not enough. Please note the bike pictured is wrapped in towels to absorb sweat. I have replaced two bottom brackets (that allow the pedals to rotate) since moving back home. I now use two fans to blow sweat away.

Slide Speed Sensor Close-up

I started using a program called gatttool on a Rhaspberry Pi to display output from a Wahoo speed sensor I mounted on the rear hub of my bike. Raspberry Pis use a linux operating system, just like the operating system I had on my own personal desktop. I moved gatttool to my PC and modified gatttool to translate my cycling exertion into a throttle position. This required the use of administrative privileges. **A way around this is to use an Arduino to do the same thing**.

Slide What is an Arduino

Here is a succinct explanation of what an Arduino is.

The Arduinos show up as devices (like a modem) on your computer and serial output is text from that device. I will use CoolTerm to show the text output from the Arduinos. I have encountered numerous devices throughout my professional career with com port outputs that were ignored by almost everyone except me.

Slide Math Used by Arduino Leonardo

The Wahoo sensor sends out 8 bytes of information every second while the wheel is spinning.

The first and last bytes were not relevant to me for achieving my goal: translating speed into a throttle position. But the middle six are. The first four bytes indicate the total number of rear wheel rotations – in other words, how far you have gone. The last two combine with the first four give a high resolution speed indication

Slide Programming Space Full

Merely capturing this information filled the programming space of Arduino Uno WIFI Rev. 2. A second Arduino is required to translate that information into a joystick throttle position.

Slide Arduino In Use

Here is a picture showing the Arduino Leonardo (joystick) and Arduino Uno Wifi Rev2 connected by wires that facilitate their communication. Both Arduinos use the wire programming library for communication.

Slide Aircraft Control Surfaces

Here is a picture an aircraft’s controls surfaces and the keys I use to control the aircraft.

Slide Todd’s Email Address

Here is my email address so I can respond to your questions after this conference. I omitted many details from this presentation.

What follows is very mathy; but I think you should understand a bit of the code in the Arduinos so you can modify it intelligently to make it work for you. You will want to know this information if you intend to use my hardware and code I am going to demonstrate.

Slide Constants

These are the constants with units. Most of the constants are obviously named except the “speedGradient” More details on that follow.

Slide SpeedGradient, SpeedDelta, MaxSpreed

The is the spreadsheet I will use to display the serial output from one of your rides to help you determine your personal speed gradient.

Slide Using spreadsheet

Here are details on how to use the provided spreadsheet

[Demonstrate concept]

Slide Questions

This is not a random collection of ideas. I did not cover every detail sufficiently. I hope you have questions.

Slide list of slides

Here is a list of preceding slides if you want to show visual aid to help you ask your question.

Slide Presentation Mechanics

This is the batch file I wrote to start CoolTerm to show the serial output of the Arduinos, ShowKey to display my keystrokes in the upper left corner of the screen, and FlightGear.

Slide Pre-flight Briefing

Here a screen shot of the heads up display I watch while playing FlightGear. FlightGear includes a GPS to guide you to your virtual destination. The GPS also shows ground speed. The HUD shows

air speed,

aileron position and its trim tab,

elevator position and its trim tab,

throttle position,

aircraft heading,

altitude above ground,

altitude above sea level,

and rudder position. I use auto-coordinated flight control so the rudder control are not used except for steering on the ground.

Watch the screen closely, I never touch the 9 and 3 keys to adjust the throttle.

Now, I will attempt a virtual flight from Gaithersburg Airport to BWI wish me luck!

Slide Presentation Publicly Available

These slides are publicly available on github from the hyperlink on the slide. I spelled throttle incorrectly when I created my github site. Finding the github site is easier if you perform a google search, I think.

Check list

Turn on fanS!

**Head band**

shoes

Put on headband and left foot brace

Put on cycling shoes

Turn on BLE Arduino

Rotate rear wheel by hand

Confirm blue light is on

Double click “startApps”

When launcher opens

choose Cessna

Confirm KGAI aiport as departure

When flight gear launches

activate parking break

from “Equipment” menu set GPS to KBWI

press “h” to turn HUD

twice if you want red

press “c” to turn off cockpit

start pedaling

if throttle is active take off

restart arduino until throttle is active