2.017 Design of Electromechanical Robotic Systems, Fall 2009

Lab 3: GPS and Data Logging

1 Overview

The goal of this lab is to learn how to acquire, log, and process GPS data using the Arduino microcontroller board and the GPS logger shield. You will also learn how to interpret the GPS string, process the data in MATLAB, and to view the data on a map program.

We will spend the last half hour of the lab for project discussion.

2 Assemble the GPS Logger Shield

We ask each group to assemble a GPS logger shield:

- Grab a soldering iron and solder.
- Power the soldering iron and set the temperature dial to 4.
- Follow the on-line instructions on http://www.ladyada.net/make/gpsshield/solder.html to assemble the board.
- Also solder the 9v battery holder.
- Take your time. Don't rush.

Soldering guidelines:

- Wear safety glasses when soldering.
- Do not touch a hot iron.
- Never leave your iron turned on while unattended.
- Never set the soldering iron down on anything other than an iron stand.
- Use needle nose pliers, heat resistant gloves, or a third hand tool to hold small pieces.
- Practice a few times if you have not done soldering recently.
- Do not use excess amount of solder.
- Double check the part you want to solder before you actually do it.
- When done soldering, tinning the iron is required to protect the tip from oxidation thereby dramatically increasing its life.

3 GPS Experiments

- Download and unzip "NewSoftSerial_18-02-09.zip" and "AF_SDLog v2.zip" from http://www.ladyada.net/make/gpsshield/download.html
- Put the above two unzipped folders in your "C:\...\Arduino\hardware\libraries" folder.
- Download the file "lab3files.zip" from the course website and unzip to your lab3 folder.

• The files are described below:
o "GPStest_RMC.pde" – Arduino code by ladyada to test the serial communication with a PC.
o "GPSLogger_v3.pde" – Arduino code by ladyada to record GPS data on an SD card.
o "ReadNMEA.m" – A MATLAB function to read a recorded NMEA data file to MATLAB workspace.
• You should also download:
o "em406a_ug.pdf" <http://elmicro.com/files/sparkfun/em406a_ug.pdf> – GlobalSat GPS Engine Board document.
o "RouteConverter.exe" <http://www.routeconverter.de/downloads/en> – A freeware to view NMEA data and to convert the data to a Google Earth data file.
• Decode the following NMEA string:
o **$GPRMC,135713.000,A,4221.4955,N,07105.5817,W,4.29,258.17,310809,,*16**
o What is the location? (Hint: Enter the coordinate on Google Map to find the location.)
o When was the string acquired?

3.1 Test your GPS device

- Follow the on-line instructions on http://ladyada.net/make/gpsshield/gpstest.html to test your GPS device.
- You should see a red LED light on the GPS receiver once you power it up.
- Make sure you are getting valid GPS data on the serial monitor window.
- Once you are done with the test, you can proceed to test data logging.
- Follow the on-line instructions on http://ladyada.net/make/gpsshield/logging.html to test data logging on the SD card.
- After several minutes you should see a steady green LED and flashing red LED if the GPS receiver got a lock and data is being logged to the SD card.
- Power off the GPS (by removing the TX jumper on the upper right hand corner of the GPS shield and wait till the red LED is off) and remove the SD card after a few minutes of data logging. Reinsert the jumper.
- Copy the data file on the SD card to your computer.
- Open the file with notepad and see if the file contains GPS data string.
- If you see valid data strings then you can proceed to the next task, otherwise you need to troubleshoot the problem.

3.2 Determine the accuracy of the GPS receiver

- Plug your 9v battery to your GPS device. Bring a spare battery with you just in case.
- Go outside, pick a location and power up the device.
- Wait till you get a lock.
- Stand still to collect about 3 minute worth of data.
- Press reset.
- Use the provided MATLAB function to determine the scatter in the data after you are back from your field trip.

3.3 Take field data

- Power up your GPS device.
- Put it in an OtterBox.
- Take a walk for about an hour with your GPS device. At a minimum go out to the Charles River and walk along the river in either direction and come back. You need to stay outside to ensure good GPS reception.
- You might want to bring your lab notebook with you to manually log a few data sets (time and location) for comparison purposes.

3.4 Process GPS data

- Come back to the lab and process your data files with the provided MATLAB function.
- Make a plot of your latitude vs. longitude.
- Write a MATLAB program to compute the distance between two geological coordinates. (Hint: try the haversine formula.)
- About how far did you go?
- How fast did you walk?
- Use "RouteConverter.exe" to view and print your data file on the map.

4 Project Discussion

- Work on your project proposal.

5 Deliverables

- Assembled GPS logger shield and battery holder.
- Answer all the questions above.
- Data plots.
- Estimated GPS data scatter.
- Show the teaching staff your lab notebook.

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