

H2X: H2 eXplorer

Autonomous Dual Navigation System Vehicle

A vehicle that can autonomously navigate itself to user specified waypoints while reporting and avoiding obstacles on the way.

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User Manual

Setup

Hardware:

There are several power switches on the vehicle that have to be turned on before operating the vehicle. The switch under the back bumper from the driver's side, indicated on Figure 1, turns on the microcontroller, digital compass, GPS and ultrasonic range finder. Whenever this switch is flipped on, the vehicle is ready to accept a connection and record GPS destination coordinates. A second switch, shown in Figure 2, turns on power to the two servomotors that control vehicle steering and rotation of ultrasonic range finder. Finally, the switch indicated in Figure 3 turns on power to the main drive motor. A red LED will light up when the power switch to the main motor is turned on. A green LED (GPS signal availability) should remain off at this point. The vehicle is now ready for operation.



Figure 1

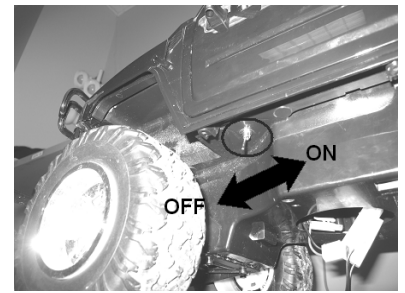


Figure 2

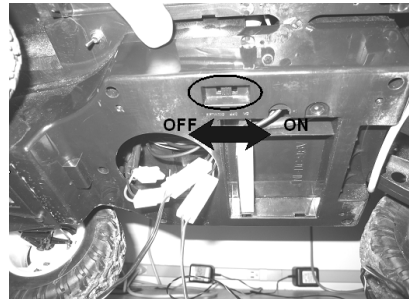


Figure 3

Placement:

The vehicle must be placed away from any metallic objects that may affect the magnetic field. The vehicle will operate incorrectly close to cars, metallic poles and areas with metallic pipes placed close under the ground surface. GPS signal is only available under the open sky, thus the vehicle must be operated outside only. Finally, the test area must be as flat as possible to avoid situations where the digital compass reports inaccurate angle information due to tilt.

Software:

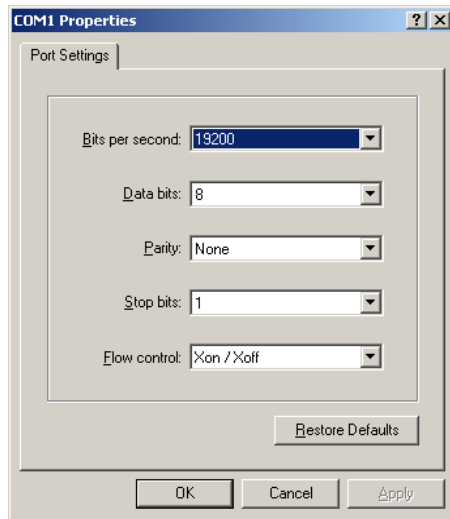


Figure 4

To establish a connection with the vehicle, the first step is to create a Windows HyperTerminal session on the serial port of the base station modem with settings shown in Figure 4.

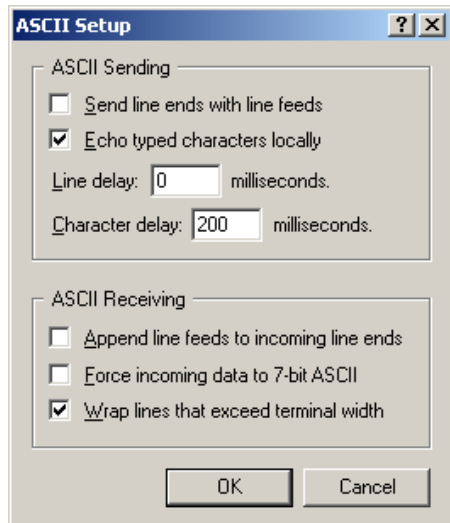


Figure 5

After the connection is created, the ASCII settings must be edited to ensure successful transmission of the destination points and commands:

File->Properties->ASCII Setup as it is shown Figure 5.

Standard modem AT commands are used to dial remote modem telephone number:

ATZ

ATD<tel number>

Usability

After the base station modem has connected to the modem on the vehicle a welcome message will be displayed as in Figure 6.

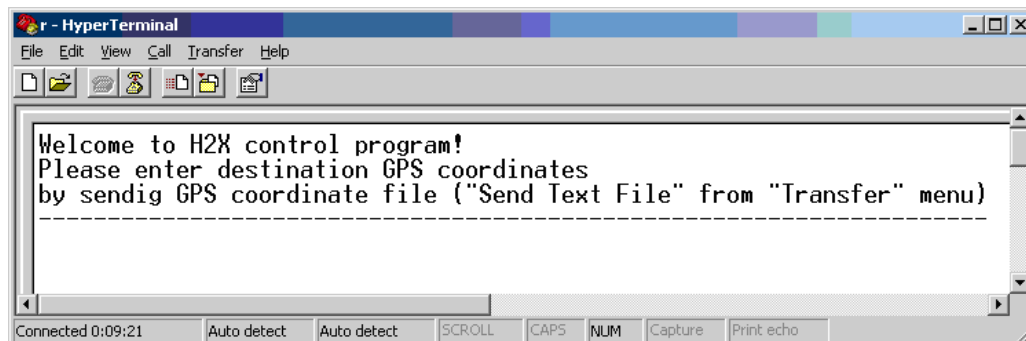


Figure 6

There will be few information messages displayed every second, as the vehicle is moving towards the destination point: encountered obstacles' GPS coordinates, distance left towards the destination, and error messages (no GPS signal, or any problems with vehicle component operation). Also, all the user commands will be acknowledged by printing command action in ASCII surrounded by <<>>. Before the vehicle can start navigation, destination coordinated must be sent to the vehicle. Up to 10 destination coordinate points can be accepted by the vehicle with the current firmware. Destination coordinates must be sent in Garmin GPRMC format. Destination coordinates can be typed in manually or sent as a text file through HyperTerminal. To send destination coordinate as a text file in Hyper Terminal, use Transfer menu as shown below in Figure 7.

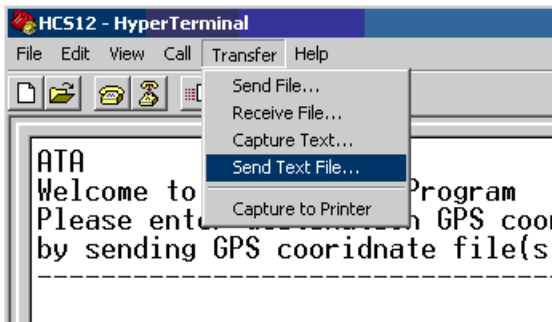


Figure 7

After the destination coordinate transmission has been successfully finished, the acknowledgement will be displayed. At this point the vehicle is ready to start navigation. ASCII character command G (g) will command the vehicle to turn on servomotors and the main motor for the navigation when GPS signal is available. The output to the HyperTerminal screen during navigation will be similar to that in Figure 8.

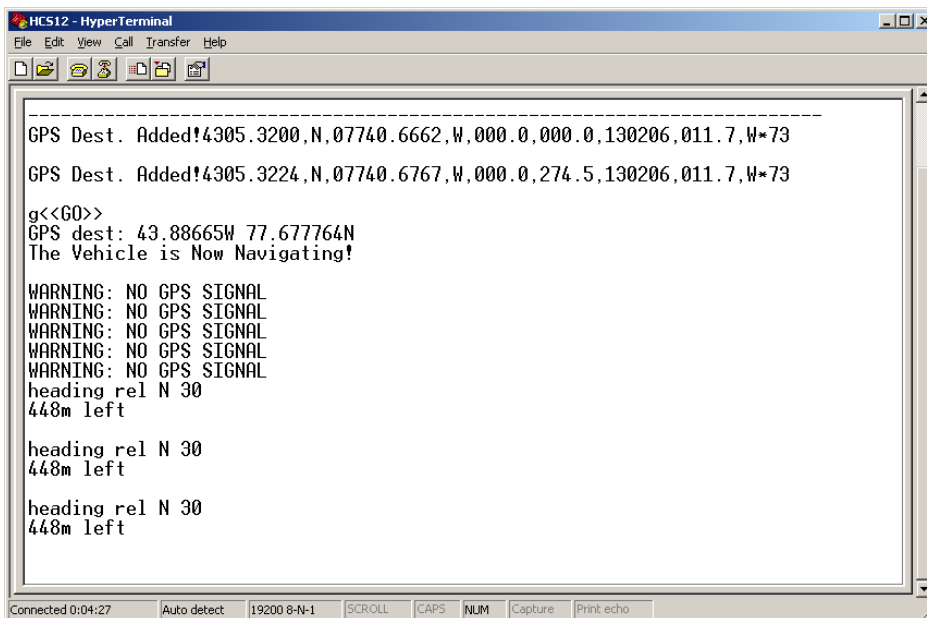


Figure 8

There following control commands available for the user:

R, r – (reset) stops the vehicle navigation, reinitializes all the vehicle components and internal program variables. The vehicle will not drop the connection call; however, it will expect standard connection strings (RING & CONNECT) to restart the program. The destination coordinate table will be lost after reset.

- P, p** – (pause) pauses the vehicle. Warning messages are still displayed (no GPS signal message). The destination meter count down will be paused.
- G, g** – (start movement & navigation) no effect while the vehicle is moving. This command resumes the vehicle from the paused state.
- S, s** – (stop) stops the vehicle; reinitializes destination table pointer to the beginning. This command does not erase destination table entries.
- C, c** – (clear destination table) stops the vehicle, erases all destination table entries.
- N, n** – (reset from the dropped call) the vehicle will perform reset if it detects NO CARRIER ASCII sequence. The destination coordinate table will be lost after reset.

GPS coordinate destination file:

GPS coordinate file should be in the following format:

```
$GPRMC, , , d d m m . m m m m , , d d d m m . m m m m , , , , , , * h h <CR><LF>
```

where latitude goes first, longitude second. The user can specify only the coordinate fields. All the characters should be exactly as they appear above. hh is XOR byte in ASCII form of all characters between \$ and *. CR and LF is hex for 0x0D and 0x0A (Enter Key)