An OO WiFi Dynamometer Van

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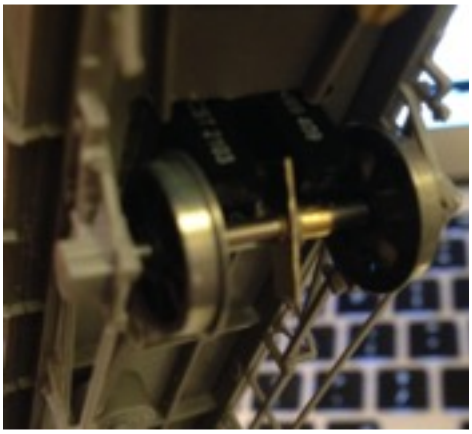
I find it hard to resist new toys with which to tinker. When I came across a new range of chips designed to support the growing trend for the "Internet of Things" I could not resist looking at how I could make use of them.

The thing that caught my eye was a small board that contains everything you needed to create a WiFi hotspot. The board is small enough to fit inside a 4mm vehicle and is available for a couple of pounds on eBay. My first thought was wireless throttles and the like, but I soon decided I wanted to do something with wireless in an item of rolling stock. The project I set myself was a real dynamometer car that would give me scale readings of the speed and distance travelled by the vehicle.

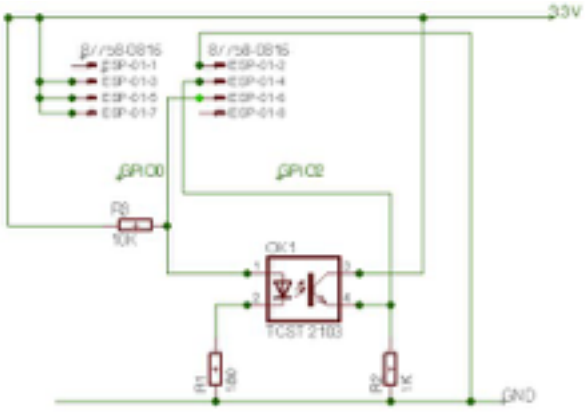


The processors not only have all that is required for wireless communication, they also feature a number of general purpose I/O pins in much the same way as an Arduino processor. My plan was to use a sensor to time the wheel revolutions of a wagon.

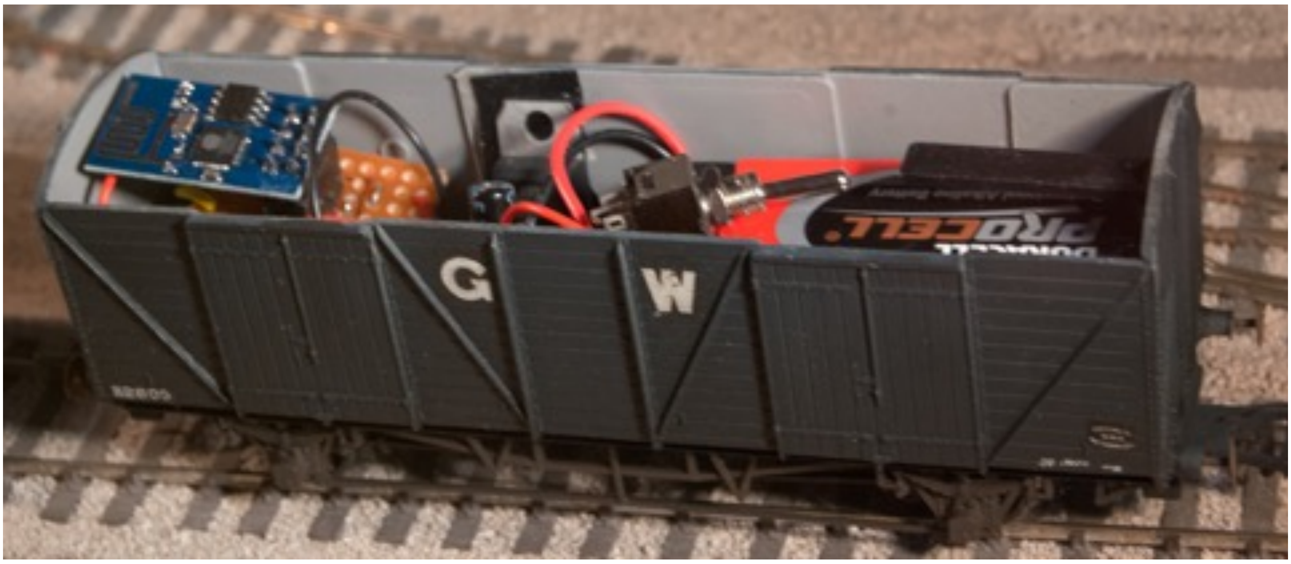
I used an interrupter sensor which is an infrared LED and a photo transistor incased in a U shaped plastic housing. I arranged this such that the "arms" of the U passed through a square hole cut in the floor of my van. A small brass strip soldered to a 2mm top hat bearing was then attached to the axle using Loctite 601. This strip would interrupt the beam twice per revolution of the wheel.

The plan was to use the cutting of the beam to cause an interrupt on the processor, the time between these interrupts could then be measured and by applying a simple bit of maths, it would be possible to measure the speed of the vehicle.

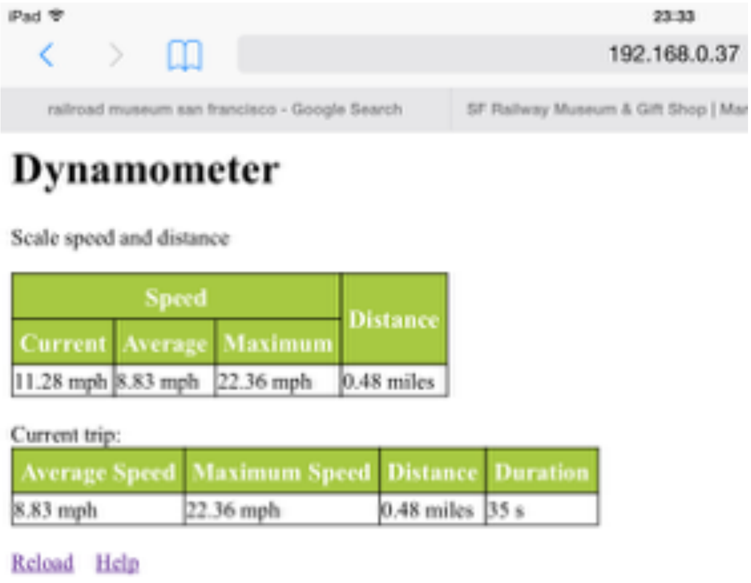
The processor I had to work with was the ESP8266. This is available on a number of different development boards. I was using the simplest of these, an ESP01. The ESP01 has an 8 way connection, however by the time power, serial communications, reset and chip select had been accounted for this only left two general purpose I/O pins available. The problem however was that these two GPIO pins are used to determine the boot mode of the processor. Therefore I could not simply attach the output of the sensor to the GPIO pin. The solution was simple - allow the processor to turn the LED on or off, this would mean that by judicious use of pull up resistors the correct voltages could be applied to the GPIO pins for the boot to occur. Once the processor is running the LED could be turned on and the sensor used to determine the wheel revolutions.



It then needed a power supply to power the 3.3 volt processor. I went for a PP3 battery stepped down to the 3.3 volts required. I could have put some pickups on the wagon, but decided against this since I did not want to risk too much friction on the wheel set that was used for measurement. Adding friction to the wheel set might cause the wheel to skid and make the measurement invalid. I could have used the other wheel sets but then I would risk loosing power over point frogs etc. The other thing I wanted was the ability to run the wagon on both DC and DCC layouts. So hence the solution was a battery. I do plan to replace it with a rechargeable one in future and have it charge via pickups on the wheel set that is not used for measurement. This will then mean that the task of periodically replacing the battery can be done away with, but that will come later. It all fits in a Parkside Dundas kit built GWR Mink A van even with the PP3 battery. It could be smaller if a different power supply was chosen. The roof is removable in order to gain access to the battery and the switch, although I aim to fit a smaller switch through the floor to enable easy access. The roof is held down with a magnet at one end and a simple clip at the other.



Next I needed the software to create the website that the van would host. I decided to build my own firmware using the Arduino IDE and the project that integrates the ESP8266 processor in that environment. The software was setup to allow the ESP01 to both connect to an existing WiFi network or for the wagon itself to act as a hotspot to allow other devices to attach to it.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Dynamometer

Scale speed and distance

Speed			Distance
Current	Average	Maximum	
11.28 mph	8.83 mph	22.36 mph	0.48 miles

Current trip:

Average Speed	Maximum Speed	Distance	Duration
8.83 mph	22.36 mph	0.48 miles	35 s

Reload Help

The software uses a WebServer library, and provides a number of pages, the main one shows the speed and distance information. This is derived by timing the interval between the beam being interrupting. As well as current speed, the average and maximum speeds are also displayed. The total number of rotations is counted to allow a distance travelled to be measured.

The software also has the concept of “current trip”. If the wagon is stationary for more than 30 seconds then it is deemed to have completed a trip. The next movement will be treated as a new trip and will be displayed as the current trip data.

The software uses an interrupt to collect the transition from light to dark when the brass strip passes between the sensor. This interrupt routine notes the current milliseconds since startup and compares this to the previous transition to determine the time it takes for a half revolution of the wheel. This data is then multiple to obtain a scale miles per hour figure and also to increment the distance travelled by half the circumference of the wheel.

There is much more that can be done with the software, including collecting telemetry data to draw graphs of speed, acceleration and braking etc. The current software and the circuit diagram is available on my GitHub pages (https://github.com/M1118/DynaVan) for anybody that is interested in building something similar. The software currently assumes a wheel diameter of 11mm, my plan is to add extra web pages that allow the wheel diameter to be set via a web form. Currently a configuration page allows the auto refresh interval and trip stationery time to be set. Other URL's also allow for control of the WiFi hotspot and for retrieving the speed and distance data as a JSON document that can be consumed by applications.

Hopefully this will give people a flavour of what could done with one of these wireless devices, it certainly provided me with a fun diversion. Perhaps it is because of these fun diversions that I never get to finish a layout.