



LS20031 Example Project: Simple GPS Odometer

A. Purpose:

To design and build a simple GPS-based odometer to track walking/running mileage.

B. Background:

My wife is training for a half marathon, and kept wondering, "How far is it from 'here' to 'there'". Mileage calculation can be done on websites such as Google and mapmywalk.com, but a handheld device can yield advantages over these sources. With a handheld odometer, one can instantaneously know mileage while exercising, which is valuable in training (i.e. - adjust pace, motivate to get to mileage checkpoint). Also, variations in route (cutting through city park or field instead of staying on road) can drastically change total mileage. The mission here was to use a GPS module, microcontroller, and LED display to track mileage while exercising.

C. Design:

I began with thoughts of grandeur, as is usually the case with projects that I undertake. I was going to have not only the odometer, but several other operating modes as well (current time, total exercise time, current speed, avg speed, etc). I decided to save those for version 2.0, and focus first on getting a simple odometer working.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The design behind the operation of the odometer is fairly simple. The device will just keep a running total in miles, which will always be displayed on two 7 segment LED displays (9.9 miles max distance displayed). The distance formula will be used to calculate the distance traveled between the current and most recent GPS readings, after conversion from Lat/Long coordinates to statute miles. This distance is then added to the total. Update is performed every 3 seconds.

D. Hardware:

This project consists of three major components: 1) Microcontroller, 2) LocoSys LS20031 GPS module, and 3) LED display. The Atmel ATMEGA168 microcontroller was used in the implementation of this project.

First, the project was implemented on a breadboard to allow for easy development and testing. In the end, the parts were permanently mounted on a small prototyping board (See Figure 1 and Figure 2 below).

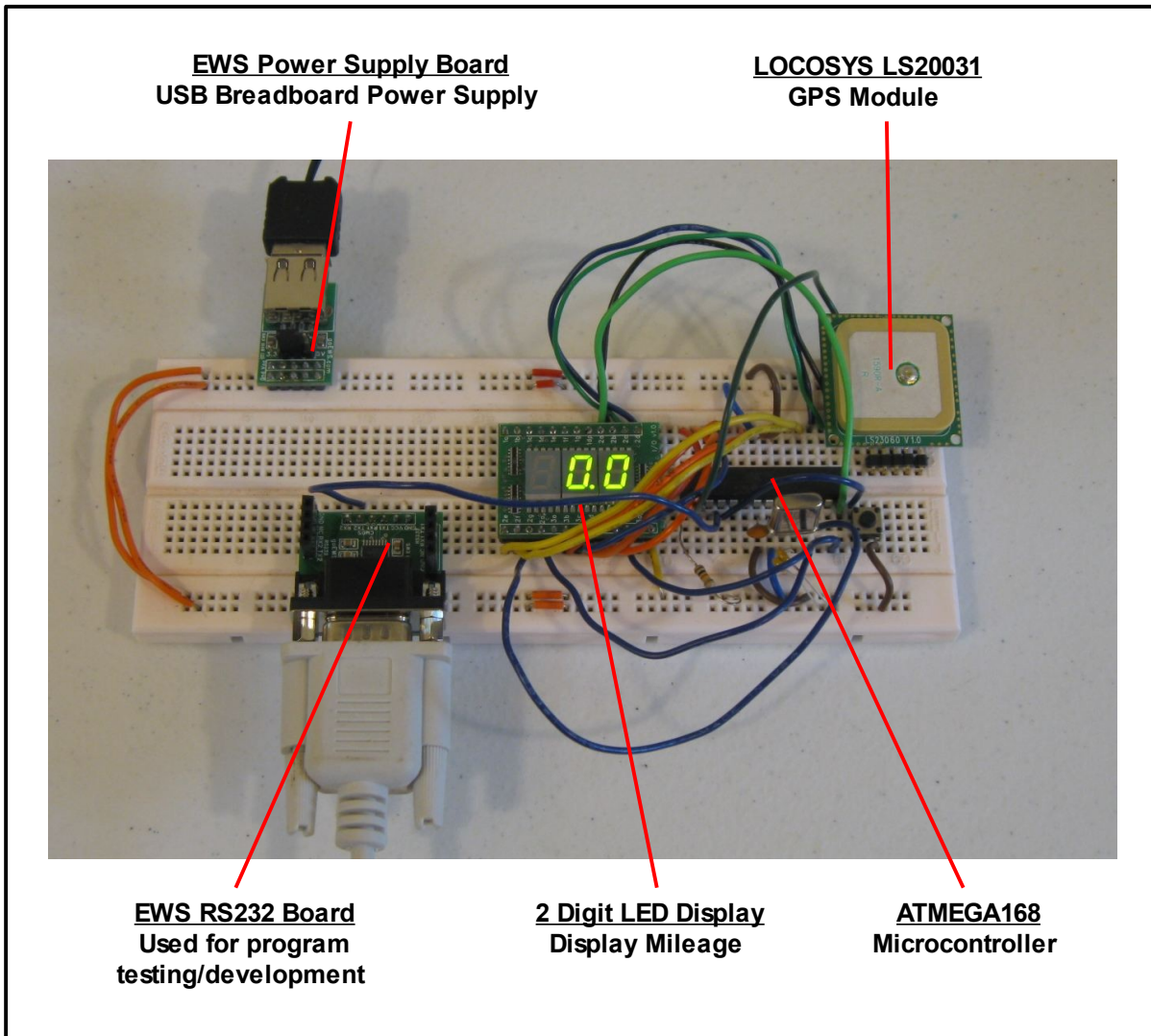


Figure 1: GPS Odometer on Breadboard

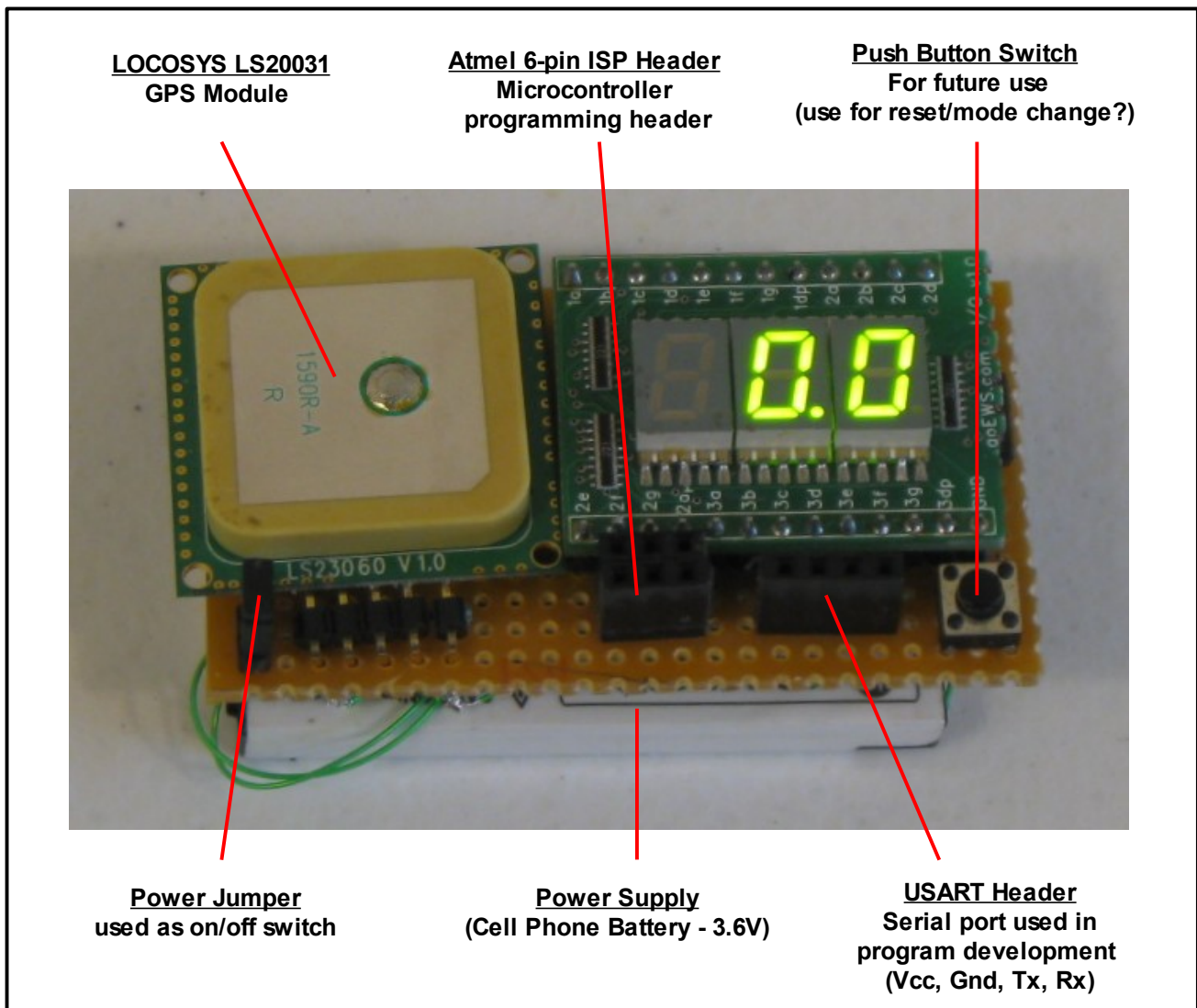


Figure 2: GPS Odometer (Working Implementation)

E. Software/IDE:

Program development was undertaken using [WINAVR](#) (WinAVR-20100110). Programs were written using Programmer's Notepad. Programming of the AVR microcontroller is via the 6-pin ISP port using the ATMEL MKII programmer (go to www.goEWS.com to download project code).

F. Testing/Results:

So, I assembled an odometer to field-test and jumped in my car with it. Initially, I had mis-entered one of the conversion multipliers in code, so the miles were accruing faster than they should, but that was easily changed. After that, it worked well. It kept on track with the mileage of my car, truck, and also test route distances obtained from [Google Maps](#). When I had it working, I started salivating about all of the functionality that I could add to it, but had to check myself and remember that this is just a first simple version to get up and running.

One of the first times I used it, I lost the jumper that is used for the on/off switch. Then I lost the next one shortly thereafter. I will change this to a permanent switch in the next version, as the jumper is small and removable, thus is easily lost.

Also, charging the battery in a cell phone is a hassle. The next version will have 3-AAA batteries instead – more capacity, more readily available, and handier to charge.

G. Conclusions:

I was very satisfied with this project. It was fairly easy to implement, and works well for the intended purpose – tracking running/walking distance. The odometer acquires position information quickly thanks to the wonderful [LOCOSYS LS20031 GPS module](#) on board. The LS20031 has battery backup and stores satellite information for very fast positioning in a warm start (quick re-start of module). As with any completed project, hindsight gives clarity for version 2.0 changes (rework on/off switch, battery change, develop more robust package, use three LED digits instead of two for greater range and/or accuracy), but this is a solid design that works to specification, and also serves as a good introduction for interfacing between an Atmel microcontroller and a LOCOSYS GPS module. In the end, my wife called it worthwhile and has been able to track her mileage with it, so I'm calling it a success.

Please [contact us via our website](#) if you have any questions or comments about the design/development of this project.