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# Youtube Video URL

<https://youtu.be/c9zCvBiX-uc>

# Purpose

The purpose of this project is to build an automatic transmission system for a bicycle. Using a satellite GPS module and an accelerometer, it detects the speed/acceleration of the bike and uses a servo motor to adjust the gear. This, theoretically, would provide the optimal bike riding experience because it would guarantee that the bike always starts in a low gear from a stop and gradually shifts at good speeds so that the rider can build speed and cruise without putting in too much effort to pedal. There is also a demo mode that overrides the gps speed and accelerometer values so that it can be demoed without a vehicle.

# Functionality

* The system starts in regular (not demo) mode
* It is in first gear
* The satellite GPS module tracks the speed of the vehicle
* The accelerometer tracks the acceleration of the vehicle to determine whether there is hard acceleration
* If there is not hard acceleration, the gears will shift every 10mph (based on car speeds for demo purposes)
* There are 6 speeds total.
* If the user is slowing down, the gears will downshift according to the speed (every 10mph) as well.
* If there is hard acceleration (based on data from the accelerometer), the system can skip a gear, when shifting up, to accommodate the rapid speed increase.
* For demo purposes, there is a demo mode which can be activated by pressing the right button on the second breadboard.
* In demo mode, the speed can be manually adjusted by moving the joystick up/down. The current gear and speed is displayed on the lcd screen.
* Pushing the joystick to the right simulates hard acceleration, which can show the gears jumping from say 1-3 instead of 1-2-3.
* Pushing the joystick left makes it go back into normal acceleration mode.
* GPS data and some information are shown through the serial monitor in demo mode, to show that those components are functioning as well.
* Pressing the left button sends the system back into regular functioning mode where it uses the speed from the GPS and accelerometer.

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# How Tested

* The system was tested using the demo mode that I implemented and by doing a real world test in a car.
* In demo mode, I used the joystick to increase and decrease the speed to cycle through all of the gears.
* I also set the acceleration to “high” and tested to see if it properly skipped gears in demo mode.
* I checked to see that the GPS module was returning data using the serial monitor. And I always have the number of satellites connected displayed on the lcd.
* I checked to see if the accelerometer was returning proper data, and it was.
* I then did a real world test by bringing it in a car.
* I drove the car to different speeds to let the GPS module track everything and shift the gears. I also did hard acceleration to see if that would work as well in a real world application.
* I checked to see whether the stepper motor was spinning as expected as well.

# Challenges/Lessons Learned

* I learned that small GPS modules can take a while to get an initial GPS connection, but then after that they are much faster.
* It was challenging getting it setup though because the antenna is small so it struggled to get its initial connection. I had to climb on the roof of my house and sit there for a long time to get it to finally connect.
* Using the GY-521 module was difficult as well. It is very sensitive to any movement/its orientation so when testing, it was almost impossible to get good data from it. When testing I had to keep it on my lap and any small movements would interfere with the data.
* Setting up a demo mode was difficult because I needed to adjust the speed/acceleration manually which meant adding a lot of pieces to the existing system’s state machines.

# Tradeoffs

* Using a gt-u7 GPS module was affordable and simple to implement using the TinyGPS++ library, but the antenna is very small and it struggles to get a strong connection sometimes.
* The demo mode is sort of a tradeoff. Ideally it would be possible to demo the system entirely running off of the modules, but this would not be possible without a vehicle that can reach the necessary speeds. This would not be realistic to bring to school to use in the demo though. And the demo mode still shows the modules providing data, it just isn’t directly using it.

# Citations

* <https://projecthub.arduino.cc/Nicholas_N/how-to-use-the-accelerometer-gyroscope-gy-521-647e65> (for learning how to use the accelerometer)
* <http://arduiniana.org/libraries/tinygpsplus/> (using the gps module)
* Used the TinyGPS++ library (GPS)
* Used the Software Serial Library (for the GPS)
* Used the Wire library (for the accelerometer)
* Used the LiquidCrystal library (for the lcd screen)