My GPS Tracker

Log Book for Science Fair 2021 By: Isabella Morison

Research Paper

Operated by the US government, GPS (Global Positioning System) is a space based radionavigation system. It is used for national defense, scientific needs, civil needs, homeland security and commercial needs, or to detect tsunamis, volcanoes and earthquakes.

In the early 1970s, DOD (The Department of Defense), wanted to ensure a stable navigation system would be available- and the first navigation satellite with timing and ranging, Navstar, in 1978, which became operational in 1993. (Thuy May, (Aug. 7, 2017)).

A GPS system has three major components: 31 satellites (which orbit earth twice a day in precise order), ground stations, and receivers. Each satellite transmits a unique signal which contains three pieces of info: Psuedorsndum code is the ID code of which satellite is tracking you, Ephemeris is current date and time, along with the health of the satellite and its position, and Almanac data is where the satellites are and orbital info. These signals then allow the GPS receivers to and compute the location of the satellite. A GPS receiver must be locked onto the signal of at least three satellites to calculate latitude and longitude of your current position, but to calculate longitude, latitude, and altitude a GPS receiver must be locked onto the signal of 4 satellites. A GPS receiver will usually lock onto the signal of 8 satellites, though that depends on the time and location. GPS signals can travel through glass and plastic but not through buildings-though more modern designs still allow the signal to travel through walls.
The satellites orbit 20,000 kms above the earth, traveling at a speed of 1400 km per hour.

GPS provides two levels of service: Standard Positioning System (SPS), which uses the coarse acquisition CA code on the L1 frequency, and the Precise Positioning System (PPS) which uses the LI and L2 frequency, which uses the PY code. PPS is restricted to US military and governments, while SPS is readily available throughout the world without any direct user charges (Thuy May, (Aug. 7, 2017)).

GPS are bulky in size, although the world's smallest GPS is smaller than a penny and weighs only 0.3 grams. (Christopher Mims, (September 5, 2011)).

Bluetooth is also used to locate things-you can even combine bluetooth and GPS and communicate over a short range wireless network. Bluetooth has many pros: cheap, low power connection, small and thin, there are rechargeable models available, and there is also anonymous search helping. Though with good comes bad-there are still cons associated with bluetooth, such as the max is only 30 meters and it is dependent on the bluetooth signal. GPS also has its pros, such as: there is a constant connection, there are rechargeable models available, although it is bulky in size, it usually costs an

upward of 50 bucks to use it, it has high power consumption, and no community help is available.
Adhesion is a physical phenomenon, where the polymers, pressure sensitive adhesives, have high viscosity liquids which will "wet" to a surface when pressed down on it. But they also have elasticity characteristics (they are visco electric), which give them elastic properties; and so they will resist separation when stressed.
GPS and adhesion are quite interesting.

Hypothesis and Testable Question

I am very scattered, and so I lose things a lot. This project is aiming at helping me find those things using GPS.

If I make this GPS tracking sticker and attach it to important items, then I will be able to find them easier with the help of GPS and associated app, because I can triangulate the exact location of my lost objects with GPS.

Materials

- 1 GPS Receiver
- 1 Uno R3 Controller Board
- 1 830 Tie Points Breadboard
- 1 Potentiometer
- 1 LCD1602 Module
- 20 Breadboard Jumper Wires
- 1 USB Cable
- 1 GPS Controller
- Arduino Program installed on computer
- A computer

Procedure

- First I bought and assembled all necessary materials.
- Next, I put together the component that would detect my current gps location.
- Next, I assembled the code to display my location to my computer.
- After this, I wired and built the LCD display, which would later display my GPS location.
- Then I coded the LCD display to display my location.

Observations

First, I took the GPS receiver and attached the end of its antenna to the left side of the GPS controller. It snapped together. Next, I took four jumper wires. On the right side of the GPS controller there were 4 holes-one labeled VCC (for power or voltage common collector), one labeled RX (for receive), one labeled TX (for transmit), and the last labeled GND for ground. I took one of the wires and soldered it in the VCC hole, and soldered the last three to RX, TX, and GND. Then take the Uno R3 board, and take the wire that is connected the VCC and inserted it in one of the holes on the left side of the Uno board that is labeled 3.3V. I connected the RX wire and inserted it into the right side of the Uno board, in the hole labeled -3. I took the TX wire and connected it to the 4 on the right side of the Uno board, beside the RX wire. I connected the GND wire and connected it to the hole on the left side of the Uno board labeled GND. Then I went to: Get GPS location from U-Blox Neo-6 and Neo-7 GPS Modules with Arduino - Robojax and read through the code there and the comments, which shows how it works. Then I went to: TinyGPS++ | Arduiniana. I scrolled down until you're at the download and installation section. I followed the instructions for downloading TinyGPS++, which is needed in the code. Then I went into arduino. I deleted the code that was already there. Then, I pasted the code from before. I pressed the symbol in the top right corner, the serial monitor. A new screen popped up. It started by showing constant messages of numbers, followed by "Location: INVALID," and the Time/Date. After about a minute or so, it started showing my location. Then I went to: ELEGOO UNO Project Super Starter Kit Tutorial - ELEGOO Official, and downloaded the PDF. I went to lesson 14, LCD Display. I grabbed the LCD model, the 16 other wires, and the breadboard. I looked at the diagrams and plugged in the wires as shown. Then, I went here: Arduino - LiquidCrystal and downloaded liquid crystal. I went into my code from before on Arduino. At the start of my code, I put #include <LiquidCrystal.h>. Then, right before the rest of my code after all of the #include statements, I put LiquidCrystal lcd(7, 8, 9, 10, 11, 12);. This initializes the library with the number of the interface pins. In void setup (), after the initialize serial code, I put lcd.begin(16, 2);, which sets up the LCD's number of columns and rows. Then after that I put: lcd.print("Item location"). This displays Item Location to the LCD. Then, under Void displayInfo (), after Serial.print(gps.location.lng(), 6);, I put LAT = gps.location.lat() LNG = gps.location.lng(); lcd.setCursor(0, 1); lcd.print("Lat:");lcd.print(LAT); lcd.print(" "); lcd.print("Lng:"); lcd.print(LNG);. Then, I clicked the serial monitor, and after a minute or so, I saw my rounded location displayed on the LCD!

Analisis

My problem did not quite solve my problem. I missed one crucial part of my design, though- the wireless aspect that would be the last crucial step to make this project functional. So i didn't really build a tracking device that would solve my main problem and function as desired, but that is ok-because a logical next step I would take would be to build the wireless aspect of my device. To cross the gap in planning I unknowingly made at the start.

Sources of Error

My experiment did and did not answer my testable question, which was if I could find my lost things with GPS, and so that becomes a source of error. I did build a GPS model which records your current location, and a LCD board to display it; but it is all connected through wires. If I had a wireless model, then my project would bridge the gap of the separate component-the things you attach to your items and the model that displays data-but I couldn't do that all in one year, and so I plan to continue on with this project next year, and find a way to make it wireless. Also, I couldn't get the technology with precise precision-it used to be limited to U.S army's, and though it is available now, it is far too pricey. This project would still help finding things that are far away, though.

Conclusion

My innovation turned out to be inconclusive. I cannot find my objects with this device yet and solve my leading problem, because since the two parts of the device (the part that displays where your items are and the part that you connect to your items) are connected. Once I find a wireless way to do this, though, this should function as planned, and solve the leading problem, and so I am doing a science fair next year on this. The finding device still does not really have a way of adhesion yet, and so is not quite a sticker like the hypothesis said it should be. I *can* display the data of the current position of my device on an LCD board. It is, in a way, still a work in progress.

Where I am in this Project Currently

I am currently working on a wireless aspect where my GPS tracker will send the location of an item to the owner. It might not help for your phone, unless you had an apple watch.

I am running into some problems with the wireless update, although I think I will be able to finish it when I get an ample power supply.

I have not found a way to get the cellphone module to work-me and my dad have tried many things to get an adequate power supply to the cellphone module, and though the device has more than enough power to power the cell phone module, not all of it can reach the cellphone module- we don't have enough current for it to reach the module. Although we have tried diodes, alternate power supplies, and resistors nothing appears to work.

Theoretically, if it worked, the owner of the lost item would send a text command to the "sticker." It would detect this and send the current location to the owner, who would search up its location on google maps, and then you have found your item!

This would work for a start, even if it takes a sim card to properly work.

Citations

Christopher Mims, (September 5, 2011), GPS Receivers now small enough to attach to almost anything, MIT Technology Review. Retrieved from:https://www.technologyreview.com/2011/09/05/257963/gps-receivers-now-small-enough-to-attach-to-almost-anything/#:~:text=With%20a%20tiny%2Denough%20GPS,and%20weighs%20only%200.3%20grams

Louis H. Sharpe, (July 14, 1997), What exactly is the physical or chemical process that makes adhesive tape sticky?, Scientific American. Retrieved from: https://www.scientificamerican.com/article/what-exactly-is-the-physi/

John Kyes, (May 22, 2020), What is GPS, Geotab. Retrieved from: https://www.geotab.com/blog/what-is-gps/

Thuy May, (Aug. 7, 2017), Global Positioning System History, NASA. Retrieved from: https://www.nasa.gov/directorates/heo/scan/communications/policy/GPS_History.html

NA, (ND), Difference between GPS trackers and Bluetooth Trackers, Chipolo. Retrieved from: https://www.chipolo.net/en/blogs/difference-between-bluetooth-trackers-and-gps-trackers#:~:t

ext=GPS%20trackers%20maintain%20a%20constant,the%20tracker%20and%20your%20device

Hart, Mikal, (N.D), Tiny GPS++, Arduiniana. Retrieved from: http://arduiniana.org/libraries/tinygpsplus/

Hart, Mikal, (Sep 9th, 2018), Get GPS location from U-Blox Neo-6 and Neo-7 GPS Modules with Arduino, Robojax. Retrieved from: https://robojax.com/learn/arduino/?vid=robojax_GPS_TinyGPSPlus

N.A, (Oct 21, 2020), ELEGOO UNO PROJECT SUPER STARTER KIT TUTORIAL, Elegoo. Retrieved from: https://www.elegoo.com/blogs/arduino-projects/elegoo-uno-project-super-starter-kit-tutorial

N.A, (N.D), LiquidCrystal Library, Arduino. Retrieved from: https://www.arduino.cc/en/Reference/LiquidCrystal