Satellite Communication Experiment 3

Application of Global Position System – GPS

1. OBJECTIVES

☑ To understand how GPS locate a position.

☑ To understand the basic navigation information provided by a GPS.

☑ To perform "on road" tracking using the NEO-M8P.

2. MATERIALS NEEDED

☑ PC installed with u-center_v20.10.exe
☑ GPS modules NEO-M8P and Pro Micro Arduino board
☑ Map set of compass or string with pens/pencils and thumb tacks

3. INTRODUCTION

There are GPS satellites (31 satellites) orbiting the earth operated by US Defence agency. These satellites are in circular Medium Earth Orbit (MEO) at an altitude of 20,200 km. GPS satellites are always sending out radio signals that can be used in five main applications: Locating a position, Tracking, Navigation, Mapping and Timing.

The two most common applications are the tracking of locations and navigation. Tracking of people, valuables, keeping watch over elderly, monitoring delivery trucks, and catching criminals are some familiar usages. Navigation is widely used by the transport industry for planning routes, and by unmanned aerial vehicles (UAVs) for resource mapping and aerial surveying.

Locating a position on earth uses two basic mathematical concepts:

i) Trilateration, which is the positioning from three distances.
ii) Distance = Rate × Time, which is the relationship between distance travelled, rate (speed) of travel and amount of time spent traveling

The first concept, trilateration, determines your position by knowing the location of orbiting GPS satellites and the distance from those satellites to your position on earth. However, to measure the distance from your position up to the satellites, we estimate the distance by using the second concept, relating distance with rate and time.

4.0 PROCEDURE

Part 1 How GPS locate a position.

1. Calculate the distance of the four satellites (A, B, C, D) to your location on the ground using the timing received from the satellites A to D shown in the tale below:

	Satellite A	Satellite B	Satellite C	Satellite D
Timing received, t sec	0.00988783s	0.00663206s	0.00502010s	0.00398925s
Distance = c x t m/s				
SCALED DISTANCE (cm) =Distance/(3500x100)				

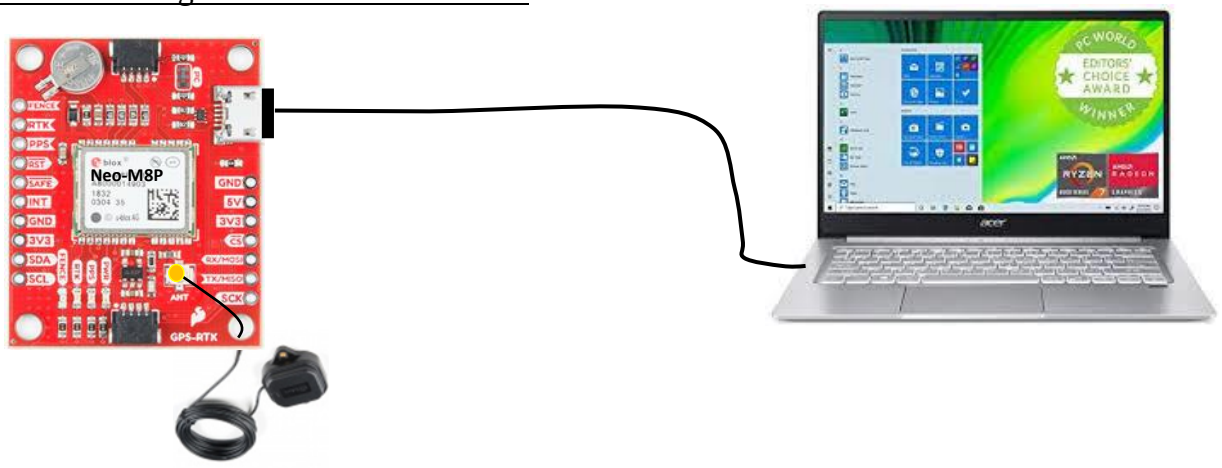
Note: We are using scaled distance (1:3500) so your location will be just an estimate.

2. The position of the satellites are marked on the Map shown below. For each satellite, take the compass with the SCALED DISTANCE fixed as radius and draw a Circle on the Map. If the circle is too big, then just the biggest Arc will do.

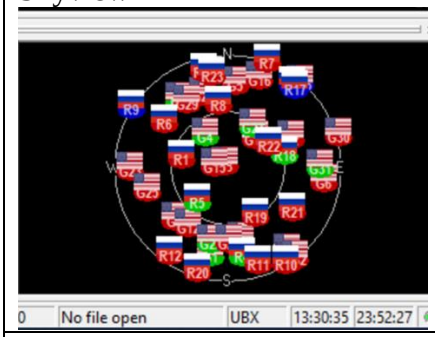
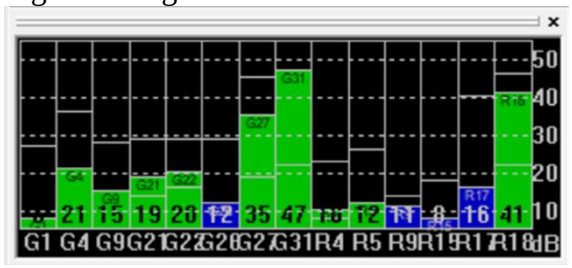
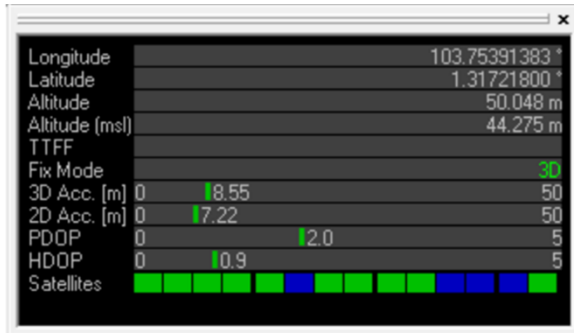
3. Repeat step 2 for Satellite B. Notice how the circle or Arc A and B intersects each other at two points. The area within these two points are your possible location.

2. Continue drawing the circle or arc for Satellite C and D, observing how your location is getting more precise each time. Notice there should only be one place on the map where all your series of arcs and circles intersect each other. This is where your location is.

Part 2: Basic navigation information for GPS

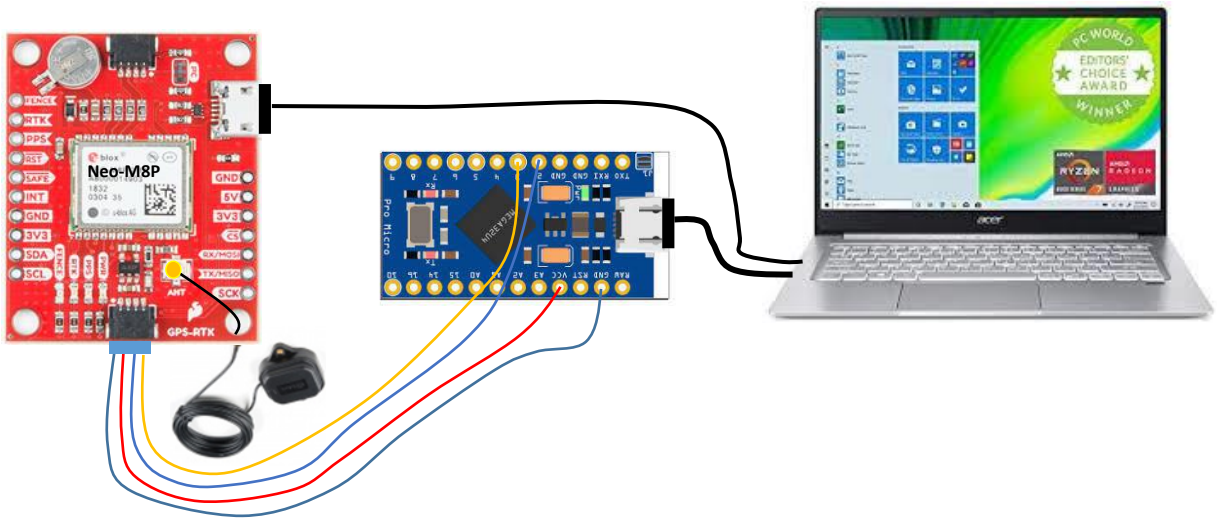


1. Connect the GPS Neo-M8P to the Laptop and launch U-center. Observe and record the following information in the table below:

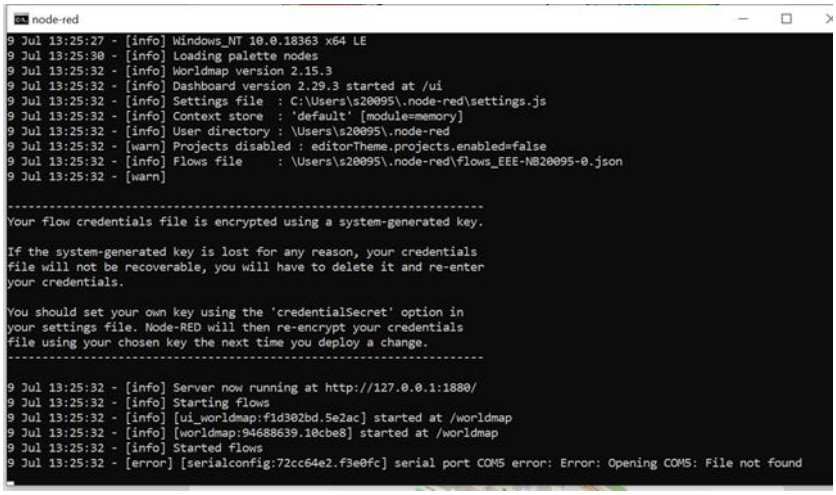
Skyview  	How many satellites are in communication link with GPS Neo-M8P? _____ _
Signal Strength  	How many satellites are of strength greater than >30? _____ _
Location coordinates  	Latitude :_____ Longitude:_____

Part 3: Tracking of location by GPS

1. Connect GPS Neo-M8P to the Arduino board as shown in the diagram below. This setup will allow the GPS to track your location and present your position on the map.



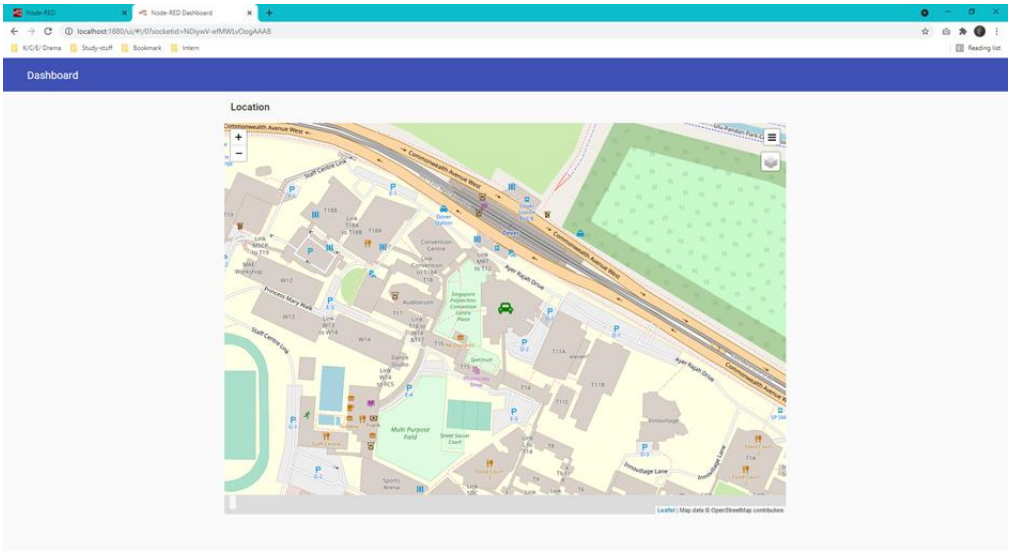
2. Press Window-R and type cmd to launch command prompt. At command prompt, type C:\users > **node-red**.



3. Launch the internet explorer and enter **Localhost:1880.**

4. Click on Com12. Check that the baudrate is 57600. Click Done. Click Deploy. Click on Debug messages to view the latitude and longitude.

5. Press CTRL+SHIFT – M to see your location on the map. Is it accurate?



6. Observe how the car position change on the map as you shift the antenna. Can you explain why?

5.0 DISCUSSION

Q1. Give three reasons how GPS may show the wrong position.

_____

_____

_____

Q2. Discuss why 3 or 4 satellites are needed to determine a position.

_____

_____

_____

Q3. Discuss the accuracy of position provided by the GPS.

_____

_____

_____