AUTOMATION LAB REPORT(EE555)

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- ## Problem
  Speed imitator using GPS and servo motor
- ## How to collect GPS data
  I have used android app called GPSLogger for collecting GPS position.
  Some small sample of data is as shown below

time	lat	lon	elevation	accuracy	bearing	speed	satellites	provider
2020-06-30T06:44:57.604Z	21.7707641	72.15274	-33.8	19.459			0	network
2020-06-30T06:45:19.000Z	21.77078355	72.15269	-26.0555	19.296		0	0	gps
2020-06-30T06:45:20.000Z	21.77075892	72.15266	-27.3244	15.008	260.9	0.9	12	gps
2020-06-30T06:45:21.000Z	21.77075263	72.15264	-32.2924	6.432	280.3	1.1	12	gps
2020-06-30T06:45:22.000Z	21.77075738	72.15263	-34.3271	5.36	268.7	1.1	12	gps
2020-06-30T06:45:16.295Z	21.770809	72.15268	-33.8	19.287			0	network
2020-06-30T06:45:23.000Z	21.77075334	72.1526	-30.1236	3.216	291.6	1.08	12	gps
2020-06-30T06:45:24.000Z	21.77074707	72.15261	-27.5486	3.216	273.6	0.38	17	gps
2020-06-30T06:45:25.000Z	21.77074995	72.1526	-29.8104	3.216	304.6	1.04	17	gps
2020-06-30T06:45:26.000Z	21.77075274	72.15261	-36.2292	3.216	321.7	0.92	18	gps
2020-06-30T06:45:27.000Z	21.77076089	72.15261	-33.7466	3.216	13.5	0.98	19	gps
2020-06-30T06:45:28.000Z	21.77077222	72.15262	-33.6535	3.216	24.2	1.04	19	gps
2020-06-30T06:45:29.000Z	21.77078093	72.15263	-31.5598	3.216	38.1	1.01	20	gps
2020-06-30T06:45:30.000Z	21.77078901	72.15264	-32.0972	3.216	37.4	1	20	gps

- ## calculate distance between two point on earth
  here we consider earth as a perfect sphere so that at every point distance from center is the same which is mean radius of earth

  d=2Πr × Θ/360= Πr×Θ/180=r(radian) × Θ

  where,
  d= Great circle distance between two point
  r= Mean radius of the earth= 6371000m and
  Θ = center subtended angle between two point
  Θ can be computed using **haversine formula** which is given by,

  $\Theta = \sin^2(\Delta latDifference/2) + \cos(lat1)*\cos(lt2)*\sin^2(\Delta lonDifference/2)$

  Where,

  ΔlatDifference = lat1 – lat2 (difference of latitude)

  ΔlonDifference = lon1 – lon2 (difference of longitude)

- **calculate speed**
  speed = Δd/Δt

  Δd =change in distance and Δt=change in time (which can be obtain from 1st column of gps data)

- **python code for speed calculation**

```
import csv

import numpy as np

from math import radians, cos, sin, asin, sqrt

def load_elements(s):

    lat = []

    lon = []

    time = []

    with open(s) as csv_file:

        csv_reader = csv.reader(csv_file, delimiter=',')


        for rows in csv_reader:

            time.append(rows[0])

            lat.append(rows[1])

            lon.append(rows[2])


    lat =  np.array(lat[1:],dtype=float)

    lon = np.array(lon[1:],dtype=float)

    time = time[1:]

    # print(time)
```

```
    h = [time[i][11:13] for i in range(len(time))]


    h = np.array(h,dtype=float)
    # print(h)
    m = [time[i][14:16] for i in range(len(time))]
    m = np.array(m,dtype=float)
    # print(m)
    s = [time[i][17:23] for i in range(len(time))]
    s = np.array(s,dtype=float)
    # print(s)
    return lat,lon,h,m,s


lat,lon,h,m,s = load_elements("gps_data.csv")
distance = []
time = []
for i in range(lat.shape[0]-1):
    lon1 = radians(lon[i])
    lon2 = radians(lon[i+1])
    lat1 = radians(lat[i])
    lat2 = radians(lat[i+1])


    # Haversine formula
    dlon = lon2 - lon1
    dlat = lat2 - lat1
```

```
    a = sin(dlat / 2)**2 + cos(lat1) * cos(lat2) * sin(dlon / 2)**2


    c = 2 * asin(sqrt(a))


    # Radius of earth in meters. Use 3956 for miles
    r = 6371000
    distance.append(r*c)



for i in range(h.shape[0]-1):
    time.append((s[i+1] - s[i]) + (m[i+1] - m[i])*60 + (h[i+1] - h[i])*3600)


print(time)
time = np.array(time)
distance = np.array(distance)
speed = distance/time


speed[np.isnan(speed)] = 0
#removing all the negative speed and negative time
speed=speed[speed>=0]
time=time[time>=0]


#scale speed by 100 for fine tuning in arduino
speed=speed*100
```

```
print(speed)



#serial communication

import time

import serial

arduinoData=serial.serial('com4',9600)

for i in range(len(speed)):

   arduinoData.write(str(speed[i]))
   time.sleep(1)    #wait for 1sec for next data
```

- Arduino code

  Here Arduino receive serial data which is speed at every 1 sec using serial connection from pc and from that speed of servo motor can be controlled.

  I'm using continuous servo for speed control as I don't want position of servo for every iteration.

  Arduino code for this is given below

```
#include <Servo.h>
Servo servo;
int mi=0;
int mx=1300;
int spd=0;
void setup() {
Serial.begin(9600);
servo.attach(9);


}

void loop() {
if(Serial.available() > 0)
{
spd= Serial.read();      //Read the incoming data and store it into variable spd(speed)
Serial.print(spd);       //Print Value of Incoming_value in Serial monitor
```

```
Serial.print("\n");//New line
map(spd,0,1300,1500,2000);// convert spped from 0-1300 to 1500-2000, 1500 zero speed and
2000 maximum speed
servo.writeMicroseconds(spd);
delay(1000);
}
}
```