

Analysis of Road Traffic Congestion using GPS NMEA-0183 Sentences in Telematics Information Management System

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Abstract

Road traffic congestion can slow down the vehicles travelling on the road; increases travel time for the drivers and passengers, increases the fuel consumptions. In this paper, we have written an Android Application which is locating the vehicle in real-time using A-GPS and GPRS in the Android Phone. It generates a NMEA-0183 standard data which in turn latitude, longitude, time, speed can be extracted; and using reverse geo-coding address has been extracted. One more feature which is been added is it writes the data back to the text and csv file. These files are further analyzed for traffic congestion.

Keywords: GPS; Android; NMEA-0183; latitude; longitude; Time; Speed; Address.

1. Introduction

Telematics as the name says utilizes media transmission medium so as to screen the data identifying with the vehicle or the whole armada. Telematics Information Management System (TIMS) assembles the data identifying with the vehicle area, driver's conduct, and vehicle motor attributes and imagines the information on the product stages for additional investigation or observing.

How Telematics Works?

TIMS gathers the information related to GPS (global positioning system), sensor (accelerometer, gyroscope) and vehicle engine data from all vehicles in order to track, analyze and monitor in real-time as shown in Fig 1.

Global Positioning System (GPS) technology - controls live perceivability into vehicle area, speed and development inside focal points through geo-fencing. [2] [2]

Sensors – empower the catch of information on driver movement, including forceful speeding up, unforgiving braking and whimsical cornering, however sensors can be utilized to screen any in-vehicle action, for example, an entryway opening, tail lift raising and even trailer temperature. [2]

Engine diagnostics- these arrangements pull information straightforwardly from the in vehicle diagnostics framework and are basically used to

accumulate continuous information on eco-friendliness and vehicle odometer readings that help power computerized armada upkeep arrangements. [2]

Why Telematics is important?

Following are few points which describe the importance of telematics information system:

It improves driving performance.

Vehicle monitoring system improves driver awareness

Reduced insurance premiums.

Reduced time and maintenance cost

Reduced fuel costs

Reduced accident frequency [11].

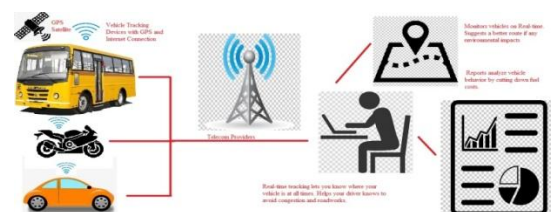


Figure 1: Telematics Information Management System

National Marine Electronics Association (NMEA) has defined and controlled a standard called NMEA-0183 which consolidates electrical and information particular for correspondence with marine gadgets sonars, gyrocompass, autopilot, GPS recipients. NMEA-0183 has replaced earlier NMEA-0180 and NMEA-0182 standards.

There are newer standards like NMEA-2000 too. The NMEA-0183 standard uses ASCII serial communication protocol to transmit data from one talker to multiple listeners [12].

In this paper Section II refers to Related Work, Section III refers to the working of GPS NMEA-0183 sentences, Section IV refers to experimentation results, Section V refers to Conclusion and Section VI refers to future scope and Section VII refers to References.

2. Related Work

Coleman's [3] paper uses a novel approach to parse NMEA standards on mobile platforms. GPS transceiver is connected to mobile device using the Bluetooth. They have used MVC architecture for self-healing parse the NMEA standard and they have compared with other parsers which is parsing the public data. The self-healing parser which is been used is approximately 50% smaller the size of the next closest parser.

Pochmara et al [4] in the paper implements a GSM and GPRS +GPS module with the combination of NMEA standard and AT commands it is capable of producing telecommunication standards. Through the satellites the GPS module gets the signals in NMEA-0183 standard which is then parsed with only certain codes and through GSM module, the data is been passed to mobile device using SMS. The application used in this paper can be used as base to use it for any complex applications.

Ariffin et al [5] in the paper the GPS module will extract the latitude and longitude values along with bearing angles between two positions. The data which is extracted from GPS module is been parsed by NMEA standard sentences. GPS NMEA standard sentences are read and have extracted useful information such as latitude, longitude and they have measured the distance between two locations in Kms. The GPS receiver which they have used in this paper and algorithm which they have used to extract latitude and longitude values from NMEA sentences have been 90% accurate and the distance between two have been shown 90% accurate enough.

Shoab et al [6] in the paper they have used GPS receiver which uses NMEA interpreter which provides the information about latitude, longitude, speed, time, Elevation and PDOP. The author has developed the application in Vb.Net. The author developed the application in Vb.Net. They have given in tabular format for GPS NMEA sentences along with descriptions. The author has extracted latitude, longitude, speed, elevation, no. of satellites and time information from NMEA sentences. The author has created progressively, in view of time and speed chart they have broken down the traffic clog and discovered the areas where the vehicles are halted.

3. GPS NMEA-0183

NMEA represents National Marine Electronics Association. NMEA-0183 standard is a blend of electrical

and information detail for correspondence between gadgets built up by National Marine Electronics Association (NMEA). GPS handsets have utilized this convention as a true standard for correspondence. All NMEA standard information is transmitted as sentences. Most of the sentences are prefixed by \$ sign and followed by GL (**GLONASS Receiver**) or GP (**Global Positioning System (GPS)**). **The sentence is followed by any of following messages:**

Table I: Message with description

Message	Description
GSV	Detailed Satellite data
GSA	Overall Satellite data
VTG	Vector track an Speed over the Ground
RMC	recommended minimum data for gps
GGA	Fix information
GLL	Lat/Long data

For Example:

If NMEA-0183 sentence is:

Latitude: 13.10362843
Longitude: 77.60005859
Time: 02:03:19:07:53:14
Speed: 2.04
Address: Yelahanka, R T Nagar, Venkata
Village, Chowdeshwari Layout, Yelahanka, Bengaluru,
Karnataka 560064, India
null

\$GPGSV,4,2,14,14,37,001,31,16,08,188,28,18,40,292,26,
20,23,116,19*71
\$GPGSV,4,3,14,22,12,322,17,25,12,061,15,26,27,165,22,
27,09,212,23*75
\$GPGSV,4,4,14,31,80,351,23,32,30,022,16*75
\$GLGSV,3,1,10,78,37,184,13,66,28,045,14,82,23,272,22
,76,18,032,15*6D
\$GLGSV,3,2,10,81,23,217,18,67,22,347,26,77,69,091,,6
5,01,099,*60
\$GLGSV,3,3,10,88,01,177,,83,02,316,*69
\$BDGSV,2,1,08,203,48,109,21,207,47,098,24,208,11,16
3,16,210,51,132,22*6A
\$BDGSV,2,2,08,211,14,267,18,212,14,188,27,213,31,17
5,24,214,22,327,25*6C
\$GPGSA,A,3,01,08,10,11,14,16,18,20,22,25,26,27,0.9,0.
5,0.7*3E
\$GPVTG,53.0,T,53.0,M,4.0,N,7.3,K,D*26
\$GPRMC,022314,A,1306.217706,N,07736.003515,E,4.0
,53.0,020319,1.1,W,D*37
\$GPGGA,022314,1306.217706,N,07736.003515,E,2,14,0
.5,896.0,M,-84.0,M,*67

1.\$GPGSV,4,2,14,14,37,001,31,16,08,188,28,18,40,292,2
6,20,23,116,19*71

Where:

GSV Satellites in view
4 Number of sentences for full data
2 sentence 1 of 2

14 Number of satellites in view
14,16,18,20 Satellite PRN number
37,08,40,23 Elevation, degrees
001,188,292,116 Azimuth, degrees
31,28,26,19 SNR - higher is better for up to 4 satellites per sentence
*71 the checksum data, always begins with *

2.\$GPGSA,A,3,01,08,10,11,14,16,18,20,22,25,26,27,0.9,0.5,0.7*3E

Where:

GSA Satellite status
A Auto selection of 2D or 3D fix (M = manual)
3 3D fix - values include: 1 = no fix
2 = 2D fix
3 = 3D fix
01, 08...27 PRNs of satellites used for fix
0.9 PDOP (dilution of precision)
0.5 Horizontal dilution of precision (HDOP)
0.7 Vertical dilution of precision (VDOP)
*3E the checksum data, always begins with *

3. \$GPVTG,53.0,T,53.0,M,4.0,N,7.3,K,D*26

Where:

VTG Track made good and ground speed
53.0,T True track made good (degrees)
53.0,M Magnetic track made good
4.0,N Ground speed, knots
7.3,K Ground speed, Kilometers per hour
D*26 Checksum

4.\$GPRMC,022314,A,1306.217706,N,07736.003515,E,4.0,53.0,020319,1.1,W,D*37

Where:

RMC Recommended Minimum sentence C
022314 Fix taken at 02:23:14 UTC
A Status A=active or V=Void.
1306.217706,N Latitude 13 deg 06.214950' N
07736.003515,E Longitude 77 deg 36.000590' E
4.0 Speed over the ground in knots
53.0 Track angle in degrees True
020319 Date - 02nd of March 2019
1.1,W Magnetic Variation
D*37 The checksum data, always begins with *

5.\$GPGGA,022314,1306.217706,N,07736.003515,E,2,14,0.5,896.0,M,-84.0,M,,*67

Where:

GGA Global Positioning System Fix Data
022314 Fix taken at 02:23:14 UTC
1306.217706,N Latitude 13 deg 06.214950' N
07736.003515,E Longitude 77 deg 36.000590' E
2 Fix quality: 0 = invalid
1 = GPS fix (SPS)
2 = DGPS fix
3 = PPS fix
4 = Real Time Kinematic
5 = Float RTK
6 = estimated (dead reckoning) (2.3 feature)

7 = Manual input mode

8 = Simulation mode

14 Number of satellites being tracked

0.5 Horizontal dilution of position

896.0,M Altitude, Meters, above mean sea level

-84.0,M Height of geoid (mean sea level) above

WGS84 ellipsoid

(empty field time in seconds since last DGPS update

(empty field) DGPS station ID number

*67 the checksum data, always begins with *

4. Experimentation Results

An Android application is written which shows the GPS NMEA sentences on a real-time basis. Whenever the location gets changed it starts showing the corresponding latitude, longitude, time and speed which is been extracted from the NMEA-0183 sentences. It also shows the corresponding address which is been reverse geo-coded with the latitude and longitude values.

Once the data is generated from android mobile using the built-in A-GPS, the data is been written to the file for further analysis. The data which is generated from android phone gives the reading per second whenever the location gets changed. The speed value is logged meter-per-second. The date format is in DD:MM:YY:hh:mm:ss. The latitude and longitude values are in deg.radians. Based on one trip details following table and graph details are analyzed. Based on time and speed the line graph is plotted and we can find traffic or signal in a particular area for the particular time. Also we can find at which particular area the speed is highest at a particular time.

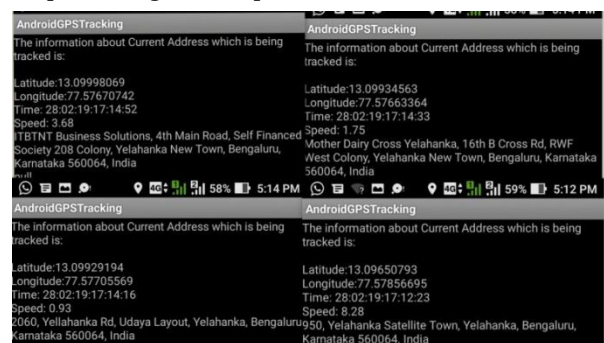


Figure 2: Real-time location in Android Application showing the details of latitude, longitude, time, speed and address

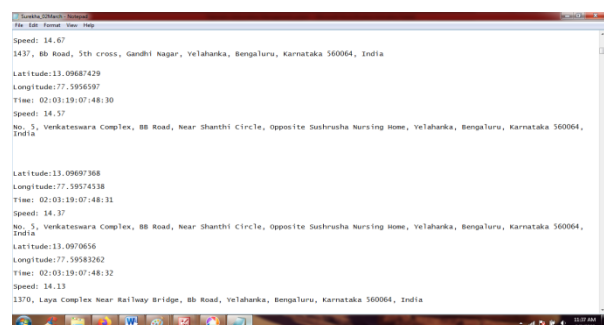


Figure 3: Data which is written to a text file in real-time.

Figure 4: Data which is written to a CSV file in real-time.

The Table II shows speed was 0 for some time interval which can be analyzed as in that particular area either there is a signal or there is slight traffic. It also shows the highest speed which can be analyzed as there is no traffic at all and vehicle can move at a particular highest speed (in terms of meter/second).

Table II: Details of the address and time where the speed was 0 (least speed) and Highest speed.

Sl.No.	Time	Speed	Address
1	64 seconds	0 m/s	MVM Cplx, Gr Flr, Santhe Circle, NH 7, BB Rd, Yelahanka, Bengaluru, Karnataka 560064, India
2	39 seconds	0 to 0.78 m/s	560064, Suggappa Layout, East Colony, Yelahanka, Bengaluru, Karnataka 560064, India
3	26 seconds	0 to 0.76 m/s	52, Vinayaka Temple Rd, Ambedkar Colony, Yelahanka, Bengaluru, Karnataka 560065, India
4	13 seconds	15.55 to 17.29 m/s	Bellahalli Main Road, Mitganahalli, Srinivasa Nagar, Bengaluru, Karnataka 562149, India

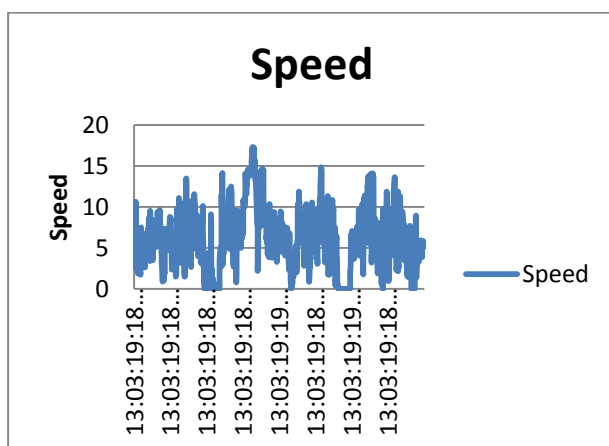


Figure 5: Speed versus time graph where it shows the speed variation with respect to time.

5. Conclusion

In this paper we have written an Android Application which is locating the vehicle (car, bike, bus, fleet etc.)

using A-GPS and GPRS from android phone. Internet and Location should be ON in android device to run this APP. The data which is generated by the app is written in the text and CSV file for further analysis. Real-time location in Android Application shows the details of latitude, longitude, time, speed and address along with NMEA-0183 sentences generated by GPS device. Time v/s speed graph are plotted to analyze the places where road traffic congestion is more.

6. Future Scope

In this paper the data is coming in the text format. The data generated by A-GPS is NMEA-0183, latitude, longitude, time, speed and address is in text format. In future we are going to embed Google Maps API which will locate the address in the Maps. This will helps us to analyze the data even better. And we are even planning to use recommender systems which will recommend a better route.

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