GPS solutions for tracking applications in steel industry

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Abstract:

GPS (Global Positioning System) is a satellite based radio navigation system. The unique feature of this system is that it allows users to determine their three dimensional position, velocity and time anywhere in the world be it land, sea or air. Like many other applications initially developed for military purpose, it is now being increasingly used for civilian purposes.

GPS based vehicle tracking system can have various interesting and extremely useful applications in steel industry involving raw material handling, hot metal and steel ladle movement, dispatch of finished products etc.

1.0 Introduction

Integrated steel plant rely heavily on rail and road transport for transportation of goods inside the plant. Generally, this network encompasses the entire plant premises, connecting all major shops and stockyards. Management of this huge infrastructure poses a stiff challenge and its smooth functioning has a substantial impact on overall productivity of the plant. This traffic management can be eased and made more efficient and productive through the installation of a GPS-based vehicle tracking system.

2.0 Vehicle tracking system

As the name suggests, vehicle tracking system is a technology used for tracking vehicles. In this system the GPS provides the data to locate an object in 3D space. This data can be transmitted to a computer system with GIS based vehicle-tracking software either in real time or in passive off-line mode. This classifies vehicle tacking in two different categories, real time and passive. In passive tracking, the GPS data logger is installed in the vehicle and the data is downloaded into a PC running on a periodic basis. Typical passive systems have a 30 days data recording facility at a 30 seconds interval.

In real-time vehicle tracking system there is an in vehicle unit comprising of a GPS receiver and a communication module. In central control room there is a similar communication module hooked up to a PC having vehicle tracking software. Each mobile unit reports its position to the base station over a communication network. Fig 1 shows the schematic of a GPS based vehicle tracking system.

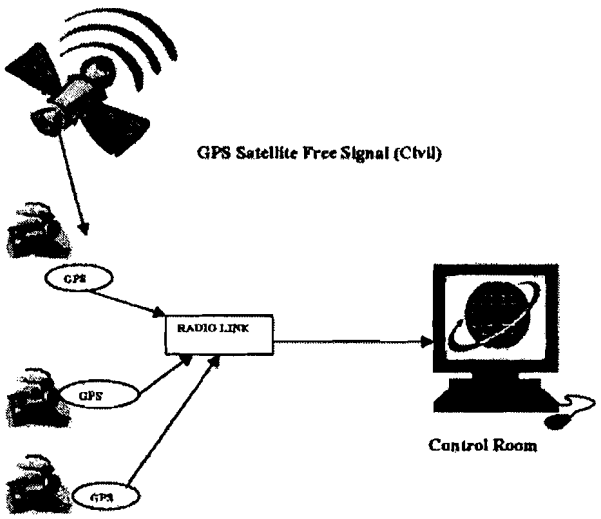


FIG 1: Schematic of GPS based Automatic Vehicle Tracking system .

The most crucial part of any tracking system is the data communication link between the vehicle and the base control station. The communication media could be conventional radio, cellular or satellite communications. In steel plant environment, VHF based radios is found to be most suitable because of the limited range required over a confined region and the one time fixed investment associated with it.

3.0 Vehicle tracking software

The Vehicle tracking software essentially processes the data generated by GPS in terms of latitude, longitude, velocity and time for any given location. Huge amount of data is generated during tracking operation, which is transformed into relevant information. The vehicle tracking software can essentially be divided into three modules, namely Communication, GIS (Geographical Information System) and Database. The communication module collects data from the vehicle either in real time or passively by downloading the data at periodic intervals. GIS or mapping relates to having a digital map of the site, where the vehicle is required to be tracked. In India, generally the digital map of the remote sites does not exist. Therefore, vehicle tracking software should be developed around built-in map utility, which in-turn will help for rapid deployment of the system at remote site. Additionally, track point mapping based on latitude and longitude of working region can be saved into a database, which can be referred to draw mimic diagrams. The database not only stores track points but also manages information about vehicles, drivers, trips, GPS data loggers etc.

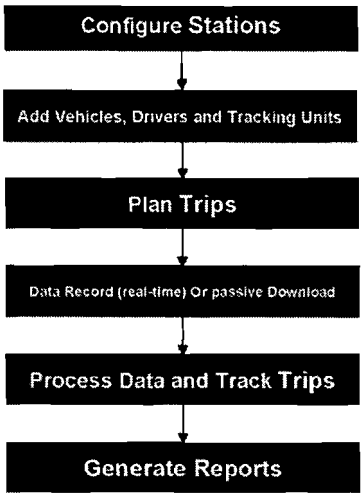


Fig 2: Basic Flow For Tracking Software

4.0 Real-life deployment scenario in steel plant

Deployment of such a system in Blast Furnace (BF) zone of steel plant is briefly presented here. There are five blast furnaces and each of these furnaces are tapped for hot metal at pre-defined intervals. The liquid hot metal is transported to steel melting shops in Hot-Metal (HM) ladles. On an average the ladle circulation time varies widely between 4 hrs to 7 hrs due to various operational constraints. This eventually demands more number of HM ladles and locomotives in circulation to compensate the deviation in turn around time of ladles. The GPS based tracking system for HM ladles pulled by locomotives will continuously provide the exact location of ladles inside the steel plant, which will help to plan the ladle movement from a central location. The major benefits include reduction in ladle circulation time, lesser loco-run-hour, lower heat loses during transfer of hot metal to mixer etc. Fig 3 shows the mimic diagram of ladle movement network at Bokaro Steel Plant.

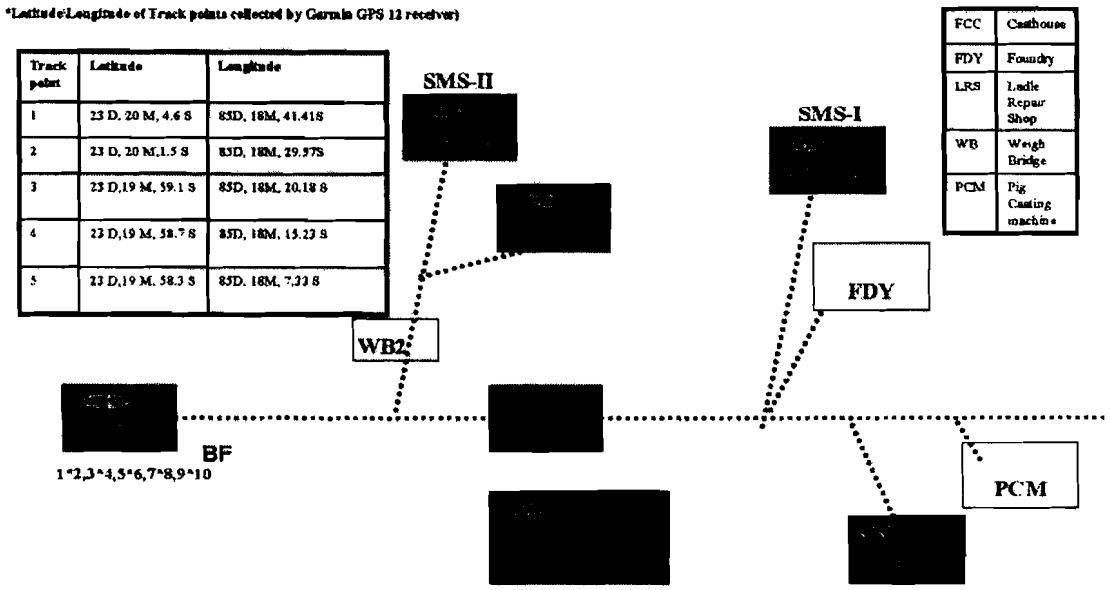
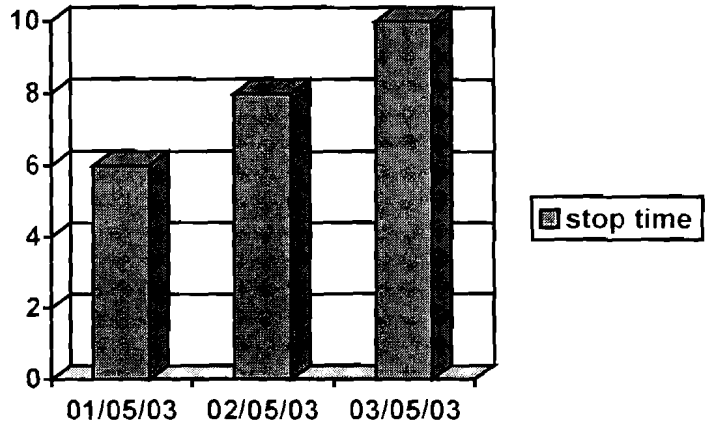


Fig 3. Mimic diagram based on pre-defined track points of site.

Based on the recorded data, the software generates the actual vehicle trips on the map. The users can trace the paths of vehicles between any two dates. For selected vehicle, the software will generate a trip summary report that includes information's like total number of stops and times at the predefined points, total number of stops and stoppages outside the schedule stops etc. The software also generates a trip detailed report for selected vehicle and two dates indicating start location and departure date\time, driving time, stop location, distance between start and stop location etc. A sample report is given below.

LADLE TRACKING START-STOP REPORT

Stop time of Ladle no.-26 in last 3 days



Location: BF, Bokaro Steel Plant, Route: CastHouse - Mixer - CastHouse
Report Date: 2-5-2002, Report Time: 4:00 PM
Time Interval: 1 Minute, Start Time: 12:00 PM, Stop Time: 4:00 PM

Begin	End	Stop Duration	Transit Duration	Action Type	Location Name	Max Speed (Km/hr)	Distance (Km)
12:54 PM	12:54 PM			Begin	Cast House		
12:54	1:00 PM		00:06	In Transit	In Transit	20	1.00
1:00 PM	**1:05 PM**	**00:05**		**Stop**	**Weigh Bridge -2**		
1:05 PM	1:10 PM		00:05	In Transit	In Transit	5	2.03
1:10PM	**2:15 PM**	**01:05**		**Stop**	**Mixer II**		
2:10 PM	2:15 PM		00:05	In Transit	In Transit	10	1.13
2:15 PM	**2:20 PM**	**00:05**		**Stop**	**LRS-II**		
2:20 PM	2:54 PM		00:34	In Transit	In Transit	31	2.36
2:54 PM	**3:54 PM**	**01:00**		**Stop**	**Cast House**		
	3:00	**2:15**	**00:50**				**6.52**

5.0 Conclusions

GPS solutions for steel plant applications can lead to optimization of fleet size, reduction in vehicle run-hour, fuel savings etc. The GPS and VHF based vehicle tracking system costs twice more than a conventional voice only radio network, but with more quantified benefits.

6.0 References

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