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Importance of GPS (Global Positioning System) Systems in Making Car Traffic Safer

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Annotation: By monitoring driver behavior and providing real-time feedback, these systems help promote safer driving practices. Excessive speeding, sudden acceleration or deceleration, and other unsafe driving behaviors can be identified through GPS tracking data.In this article, we will consider the reason why segmentation stands out among them and the solutions to existing problems.

Key words: Global Positioning System, technology, car, traffic, automatic, management, operations, information, location, system, vehicle, optimization, navigation, safety, drivers, transit, service, innovation.

Introduction: GPS (Global Positioning System) technology has transformed the way we track vehicles, offering a multitude of benefits for individuals and businesses alike. With its ability to accurately pinpoint the location of a car in real-time, GPS has revolutionized car tracking and provided numerous advantages that improve safety, efficiency, and overall operations. In this article, we will delve into the various benefits of GPS for car tracking in more detail.Global positioning system (G.P.S.) - its role in advanced transportation projects is inseparable is become a synonym. We people, whenever like to talk or take a project that will automate the management and operations of vehicles giving real-time information to users, that will lead to cost-effective satisfied service to customers/passengers, and then planners and other decision-making authorities will not find any other effective tool to select except G.P.S.

What is GPS?

GPS, which stands for Global Positioning System, is the only system today able to show you your exact position on the Earth anytime, in any weather, anywhere. Ground stations, located worldwide, continuously monitor them. The satellites transmit signals that can be detected by anyone with a GPS receiver. Using the receiver, you can determine your location with great precision. GPS is one of history's most exciting and revolutionary developments, and new uses for it are constantly being discovered.

How does GPS for car tracking benefit us?

One of the primary advantages of GPS car tracking is the ability to monitor and track the real-time location of vehicles. GPS devices installed in cars receive signals from satellites orbiting the Earth, allowing them to determine the vehicle's exact geographical coordinates. This real-time tracking feature offers invaluable information to individuals and businesses, enabling them to monitor their vehicles' positions at any given time. Whether it's tracking a personal car for security purposes or managing an entire fleet of vehicles for a business, real-time location data helps in making informed decisions and streamlining operations.

Theft prevention and vehicle recovery are significant benefits of GPS car tracking systems. A vehicle equipped with a GPS device becomes less appealing to potential thieves because the chances of being caught and apprehended increase significantly. In the unfortunate event of a theft, GPS tracking allows for a swift recovery. Law enforcement agencies can use the real-time

location data provided by the GPS device to track and retrieve the stolen vehicle promptly. This not only minimizes losses for individuals and businesses but also acts as a deterrent to potential thieves, reducing the overall rate of vehicle theft.

For businesses with a fleet of vehicles, GPS car tracking provides invaluable assistance in fleet management. Fleet managers can monitor the location and movement of all vehicles simultaneously, enabling efficient dispatching and route planning. By tracking the vehicles' real-time positions, managers can assign tasks to the nearest available vehicle, reducing response times and improving customer service. Additionally, GPS tracking allows for better route optimization, taking into account factors such as traffic congestion and road conditions. This optimization leads to reduced fuel consumption, lower operational costs, and improved overall efficiency.

GPS car tracking systems also contribute to enhancing driver safety. By monitoring driver behavior and providing real-time feedback, these systems help promote safer driving practices. Excessive speeding, sudden acceleration or deceleration, and other unsafe driving behaviors can be identified through GPS tracking data. Fleet managers can use this information to provide appropriate training and feedback to drivers, emphasizing the importance of adhering to speed limits, maintaining safe distances, and practicing defensive driving. By improving driver safety, GPS car tracking systems help reduce the risk of accidents and create a safer road environment for all.

Efficient dispatching and routing are further advantages of GPS car tracking. Fleet managers can make informed decisions on which vehicle to dispatch for a particular job based on its real-time location and proximity to the destination. By choosing the nearest available vehicle, response times are minimized, and customer satisfaction is increased. Moreover, GPS devices can incorporate real-time traffic information into the routing algorithm, allowing drivers to avoid congested routes and reach their destinations faster. This not only saves time but also reduces fuel consumption and environmental impact.

Maintenance and service reminders are an additional benefit of GPS car tracking systems. By monitoring vehicle usage and mileage, these systems can provide automated reminders for routine maintenance tasks. Regular oil changes, tire rotations, and other preventive maintenance measures are crucial for keeping vehicles in optimal condition. GPS tracking ensures that these tasks are not overlooked, reducing the risk of breakdowns and costly repairs. By promoting proactive maintenance, GPS car tracking systems extend the lifespan of vehicles, reducing operational downtime and improving overall reliability.

Insurance benefits are also associated with GPS car tracking systems. Some insurance companies offer discounted premiums for vehicles equipped with GPS devices. The ability to track and recover stolen vehicles, combined with the enhanced driver safety features provided by GPS tracking, reduces the risk profile of insured vehicles. This reduction in risk translates into lower insurance costs for the policyholders. By installing GPS car tracking systems, individuals and businesses can not only protect their vehicles but also benefit from potential insurance savings.

Data and analytics play a crucial role in GPS car tracking systems. The devices collect a wealth of data related to vehicle movement, speed, mileage, and other important metrics. This data can be analyzed to gain insights into various aspects of vehicle operations. Businesses can assess driver performance, fuel consumption patterns, and overall fleet efficiency using the data provided by GPS tracking systems. Identifying areas for improvement becomes easier, enabling businesses to implement strategies that reduce costs, optimize operations, and enhance overall productivity.

GPS Elements

GPS has 3 parts: the space segment, the user segment, and the control segment. The space segment consists of 24 satellites, each in its own orbit 11,000 nautical miles above the Earth. The user segment consists of receivers, which you can hold in your hand or mount in your car. The control segment consists of ground stations (five of them, located around the world) that make sure the satellites are working properly. The GPS satellites each take 12 hours to orbit the Earth. Satellites are equipped with very precise clocks that keep accurate time to within three nanoseconds – that's 0.000000003, or three billionths, of a second. This precision timing is important because the receiver must determine exactly how long it takes for signals to travel from each GPS satellite. To help you understand the GPS system, let's take the three parts of the system – the satellites, the receivers, and the ground control – and discuss them in more detail.

Satellites in Space

The first GPS satellite was launched in 1978. The first 10 satellites were developmental satellites, called Block I. From 1989 to 1993, 23 production satellites, called Block II, were launched. The launch of the 24th satellite in 1994 completed the system.

Ground Control Stations and Receivers

Ground Control Stations

The GPS control, or ground, segment consists of unmanned monitor stations located around the world (Hawaii and Kwajalein in the Pacific Ocean; Diego Garcia in the Indian Ocean; Ascension Island in the Atlantic Ocean; and Colorado Springs, Colorado); a master ground station at Schriever (Falcon) Air Force Base in Colorado Springs, Colorado; and four large ground antenna stations that broadcast signals to the satellites. The stations also track and monitor the GPS satellites.

Receivers

GPS receivers can be hand carried or installed on aircraft, ships, tanks, submarines, cars, and trucks. These receivers detect, decode, and process GPS satellite signals. The typical hand-held receiver is about the size of a cellular telephone, and the newer models are even smaller weighed only 28 ounces.

How GPS Works

So you can more easily understand some of the scientific principles that make GPS work, let's discuss the basic features of the system. The principle behind GPS is the measurement of distance (or "range") between the receiver and the satellites. The satellites also tell us exactly where they are in their orbits above the Earth. It works something like this: If we know our exact distance from a satellite in space, we know we are somewhere on the surface of an imaginary sphere with radius equal to the distance to the satellite radius. If we know our exact distance from two satellites, we know that we are located somewhere on the line where the two spheres intersect. And, if we take a third measurement, there are only two possible points where we could be located. One of these is usually impossible, and the GPS receivers have mathematical methods of eliminating the impossible location.

GPS Uses in Everyday Life

The GPS system was developed to meet military needs of the Department of Defense, but new ways to use its capabilities are continually being found. The system has been used in aircraft and ships, but there are many other ways to benefit from GPS. Vehicle tracking is one of the fastest-growing GPS applications. GPS-equipped fleet vehicles, public transportation systems, delivery trucks, and courier services use receivers to monitor their locations at all times.

GPS is also helping to save lives. Many police, fire, and emergency medical service units are using GPS receivers to determine the police car, fire truck, or ambulance nearest to an emergency, enabling the quickest possible response in life-or-death situations.

Automobile manufacturers are offering moving-map displays guided by GPS receivers as an option on new vehicles. Several car companies are demonstrating GPS-equipped vehicles that give directions to drivers on display screens and through synthesized voice instructions.

GPS in Navigation

What is navigation?

Since prehistoric times, people have been trying to figure out a reliable way to tell where they are, to help guide them to where they are going, and to get them back home again. Cavemen probably used stones, when they set out hunting for food. These marks used to erased no. of times. The earliest mariners followed the coast closely to keep from getting lost. The next major developments in the quest for the perfect method of navigation were the magnetic compass and the sextant. The needle of a compass always points north, so it is always possible to know in what direction you are going. The sextant uses adjustable mirrors to measure the exact angle of the stars, moon, and sun above the horizon. However, in the early days of its use, it was only possible to determine latitude (the location on the Earth measured north or south from the equator) from the sextant observations. Sailors were still unable to determine their longitude (the location on the Earth measured east or west).

In 1761, a cabinetmaker named John Harrison developed a shipboard timepiece called a chronometer, which lost or gained only about one second a day – incredibly accurate for the time. For the next two centuries, sextants and chronometers were used in combination to provide latitude and longitude information.

In the early 20th century several radio-based navigation systems were developed, which were used widely during World War II. A few ground-based radio-navigation systems are still in use today. One drawback of using radio waves generated on the ground is that you must choose between a system that is very accurate but doesn't cover a wide area, or one that covers a wide area but is not very accurate. High-frequency radio waves (like UHF TV) can provide accurate position location but can only be picked up in a small, localized area. Lower frequency radio waves (like AM radio) can cover a larger area, but are not accurate.

Scientists decided that the only way to provide coverage for the entire world was to place high-frequency radio transmitters in space. A transmitter high above the Earth sending a high-frequency radio wave with a special coded signal can cover a large area. This is one of the main principles behind the GPS system.

Navigation can be required in land, air and water or in sea. Everyplace navigation can be provided with some modification in the process of getting the data and way of processing of data and accuracy of the data required for each purpose.

Navigation in Land

GPS improves efficiency on land as well. The capabilities of satellite navigation, when coupled with communications and modern computerized management systems can help meet many of the transportation challenges facing all modes of surface transportation.

Currently, it is being used to add a new dimension for automatic vehicle location and in-vehicle navigation systems. GPS helps motorists find their way by showing their position and intended route on dashboard displays.

The NAVSTAR and GLONASS systems use the principle of trilateration. That is, the user's receiver determines the distance from the user to each of several satellites. Since the positions of the satellites are known, either through previous publication or as part of the satellite's broadcast information, the user's position can be calculated.

Display of the position of the vehicle can be taken on an instrument of a size of a mobile phone or palmtop. A central monitoring station or service providing central station can observe the position.

Transit

Transit was the first operational satellite navigation system. The Transit system allowed the user to determine position by measuring the Doppler shift of a radio signal transmitted by the satellite. The user was able to calculate position to within a few hundred meters.

The system has several drawbacks.

The system is inherently two-dimensional.

1. The velocity of the user must be taken into account.

2. Mutual interference between the satellites restricted the total number of satellites to five. Thus, satellites would only be visible for limited periods of time.

These drawbacks pretty much eliminated aviation applications and severely limited land-based applications.

NAVSTAR

The NAVSTAR GPS system is a satellite-based radio navigation system developed and operated by the U.S. Department of Defense (DOD). The NAVSTAR system permits land, sea, and airborne users to determine their three-dimensional position, velocity, and time 24 hours a day, in all weather, anywhere in the world with a precision and accuracy far better than other radio navigation systems available today.

The NAVSTAR system performs another function besides positioning and time transfer. NAVSTAR satellites carry nuclear explosion detection equipment.

GLONASS

Current Russian satellite-based positioning system – counterpart to NAVSTAR

Sea Navigation

Satellite navigation provides unprecedented accuracy and capabilities for mariners. GPS is a powerful tool that can save a ship's navigator hours of celestial observation and calculation. GPS has improved efficient routing of vessels and enhanced safety at sea by making it possible to report a precise position to rescuers when disaster strikes.

GPS aids the fishermen in reaching the probable fishing zones (PFX) accurately and avoids blind netting. VIS system monitors the vessels on the sea at the shore station any point of time. It aids in rescuing operation in case of emergencies and helped in avoiding smuggling and poaching activities. Accesses to fast and accurate position, course, and speed information will save time and fuel through more efficient traffic routing.

Communications Systems

The transportation community already makes substantial use of communications in everyday operations. The application of different technologies to public transportation will bring about additional communications requirements. APTS and Smart

Vehicle technology will require communications for such integrated functions as:

- Bus and control center communications
- Fare payment;
- Adaptive signal systems;
- Wayside/transfer center transit and On-board information inter modal information.

Of all the APTS functions requiring communications, by far the most critical is the bus/control center link. The application of new communication technologies to the transit industry has been limited. Transport companies are now replacing their older analog communications systems with newer digital systems, and a number have converted or are planning to convert to either analog or digital trunked communications system. In a trunked system, the available spectrum is partitioned into a number of channels and received or transmitted signals are automatically directed to whatever channel is currently unused. Geographic Information Systems

A geographic information system (GIS) has been described as "A system of computer hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modularity and display of spatially referenced data…" In the transit environment, GIS can be used for solving complex planning problems, operations planning, and other management and operational needs, including AVL operations.

GIS is a combination of an electronic map and a relational database that allows a user to visualize and analyze the relationship between non-related data whose only common feature is that the information shares similar geographic location,

GIS can be used for the display and/or analysis of the following that can be linked with GPS for the fleet management.

Bus routes, streets, parking lots, facilities, shelter locations, ridership loadings, running times, scheduling, bus assignments,

Bus route maps, trip planning route choices, on-time performance data, multi-media displays, pass sales outlet planning

Customer address location, service qualification determination, and service performance statistics

Since information on GIS systems was not solicited during the data collection effort for this report, it is not possible to judge the extent of GIS deployment. However, transit operators with global positioning system AVL systems usually also have a GIS.

Automatic Vehicle Location

Use of AVL in transit applications is growing, driven by the following expected benefits:

- Increased overall dispatching and operating efficiency;
- More reliable service, promoting increased ridership;
- Quicker response to service disruptions;
- Inputs to passenger information systems;
- Increased driver and passenger safety and security;
- Quicker notice of mechanical problems with the vehicles, reducing maintenance costs;
- Inputs to traffic signal preferential treatment actuators; and

- The system operates by measuring actual real-time position of each vehicle, and relaying the information to a central location.

Automatic Passenger Counters

Automatic Passenger Counters are a well-established, automated means for collecting data on passenger boarding and alighting by time and location. These data may be used for a number of applications, both real-time and delayed, including:

- Input to dispatcher decisions on immediate corrective action
- Input to real-time passenger information systems
- Future scheduling
- Positioning new shelters for waiting passengers

The two most common technologies used to register boardings and alightings are infrared beams and treadle mats. Two infrared beams are typically placed across the passengers' path as they board or alight the vehicle. As a passenger boards, he or she interrupts the beams in a particular order, and the APC registers the boarding. Likewise, as a passenger alights, he or she interrupts the beams in the reverse order, and the APC registers the alighting. These various data regarding

- No of passengers in the bus.
- Distance up to that they traveled.
- Money collected on real-time basis.
- Enabled central control station for the total computer aided dispatch (CAD)

CAD intelligently can perform its operation such that it can control the dispatch of vehicles by taking the real time demand on the route, it can make necessary change in the route of the vehicle when the vehicle are in a congested route. This automated monitoring can reduce chances of manually taken false decisions.

Traffic Signals Priority

Rising traffic congestion all over the world calls for new Intelligent Traffic Systems that can improve public transport and vital services such as emergency vehicle operations.

The objective with the Traffic signals priority project is to create an improved emergency services in order to create

- Lower response time.
- Eliminate dangerous passing of red lights.

Provide warnings to hospitals of arriving ambulances, and to create an increased passenger satisfaction with improved public bus services in order to: ?Decrease delays.

Enable faster routes.

Provide information to passengers Giving green light to ambulances, fire fighters and other emergency vehicles allows these to pass through a city faster, cutting the response time with vital minutes.

Giving green light to buses when these are late can cut delays in bus services and thereby improve passenger satisfaction.

Going one step further and always give green light to buses can be used to cut journey time – making public transport a more attractive alternative to private transport.

General Method for providing traffic signal priority

The bus location information and predicted intersection arrival times will then be passed along to the traffic control center. The control center may use one from a set of strategies that we explore to determine if a bus should be given priority or not. For example, if the computer notices that a particular bus is running excessively behind schedule, the bus will be flagged and given a greater priority in evaluating the value of its request for green preemption. This computer system will use an algorithm to be developed to allocate priority between buses (late, on-time, express, dial-a-ride, etc.) and general traffic flow. The computer will also require input from the bus system regarding passenger loading and unloading at stops in the vicinity of the actively controlled intersections. The central controlling computer will need real-time input from traffic detectors to accurately determine the traffic volumes that conflict with the various bus movements.

Bus Priority in SCOOT

A facility was introduced as part of SCOOT 3.1 in 1995 to integrate active priority to buses or other public transport vehicles with the common SCOOT UTC system. The method of doing this is described below:

Detection and Identification

The SCOOT kernel software allows for buses to be detected either by selective vehicle detectors (SVD), i.e. using bus loops and bus-borne transponders, or by an automatic vehicle location (AVL) system as GPS. Where SCOOT is given a bus identifier as part of the bus detection, it can match this detection with a previous detection of the same bus.

Bus Modeling

Buses are modeled by SCOOT as queuing with other vehicles. This allows buses to be given priority even though other vehicles may delay them. The effect of bus lanes can also be modeled, including those, which end before the stop line.

Optimisation

The signal timings are optimized to benefit the buses by either extending a current green signal (an extension) or causing succeeding stages to occur early (a recall). Extensions can be awarded centrally, or the signal controller can be programmed to implement extensions locally on street (a local extension).

Local extension

Extensions awarded in the controller can be advantageous as they eliminate 3 to 4 seconds transmission delay from street to computer and back to street, and so allow the system to grant extensions to buses which arrive in the last few seconds of green

Recovery

Once the bus has passed through the signals, a period of recovery occurs to bring the timings back into line with the normal SCOOT optimization.

Restrictions on priority

The amount of priority given to buses can be restricted depending on the saturation of the junction as modeled by SCOOT. This means that bus priority will be most effective at junctions, which have spare capacity.

Bus SCOOT and Bus Detection Systems.

The logic of bus priority does not depend on the method of detecting buses, which can vary from system to system. The method of detection can be based on transponders; it can be derived from Automatic Vehicle Location; or it can be based on some other system that provides suitable information. Suitable information is the key element in SCOOT Bus Priority. SCOOT requires an indication of the presence of a bus on a link, the free flow journey time of the bus to the stop line and the queue clear time of a vehicle queue reaching to the bus detection position.

The presence of a bus does not have to be indicated at a fixed location on a link, and information on a bus can be presented more than once on the same link.

It is hoped that, by providing priority on a selective basis, the following benefits will be achieved:

- Improvement in travel time regularity/reliability
- Reduced passenger waiting times
- Priority targeted towards higher occupancy buses
- Reduced impact on other traffic

In London, the AVL system provides real time bus location and headway data, which is used by a new headway regularity algorithm to determine the best level of priority required for each bus.

To provide real time information to the passenger waiting at the bus stops is the one of the applications of the usefulness of the GPS in the location based services.

Bus Priority Survey Results are found in London gives reductions of the order of 16 to 22 % in the delay of vehicles in the intersection.

Accuracy of the GPS -system in signal priority

The pure GPS (General Position System) -location data is not accurate enough because of the random disturbance of the GPS -system. This is not a problem, however, for the bus detection system because the GPS -location data is used only for location of the bus stop: the bus is located only when the front door of the bus is opened at a bus stop.

The figure on the right is an example of points where the detection messages to the traffic signals are sent by the bus. Each detection area can be found from the figure. This will prove that the accuracy of the GPS -location is good enough for detecting bus stops correctly.

GPS and incident management

Incident management in a highway or in any urban road can be done effectively using GPS. When some incident is happened then disruptions in the movement of the vehicles can be tracked by the GPS transponders by sending message to the control station for help.

Conclusions

The immediate and exponential benefits offered by GPS result in a safer and more efficient transportation infrastructure, which can positively influence trade potential and economic viability of a region. GPS can truly serve as a catalyst for trade and economic growth for individual those who take advantage of it. Use of GPS in the head of navigation, fleet management and some location-based services are numerous and it depend on the technologist how they want to use it for what purpose. India also in stage to implement GPS to solve some of its problems in the field of transportation. But this is a very late start we have to go a long way to problems that now looks to be impossible to solve by using conventional methods.GPS car tracking systems offer a wide range of benefits for individuals and businesses. The ability to track the real-time location of

vehicles provides invaluable information that enhances security, improves fleet management, and promotes driver safety. GPS tracking facilitates efficient dispatching and routing, leading to reduced response times and increased customer satisfaction. Moreover, it assists in proactive maintenance, prolonging the lifespan of vehicles and minimizing operational downtime. Insurance benefits, data analytics, and cost reduction further highlight the advantages of GPS car tracking systems. By embracing this technology, individuals and businesses can optimize their operations, enhance safety, and make informed decisions based on accurate and timely information.

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