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A REVIEW ON KALMAN FILTER FOR GPS TRACKING

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ABSTRACT: This paper describes about Kalman filter is used to estimate the position of vehicle using the GPS. A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a vehicle, person, or other asset to which it is attached and to record the position of the asset at regular intervals. Real time tracking system was required that can transmit the collected information about the vehicle after regular intervals and gives you up-to-the-minute speed and location updates, including text or email. GPS vehicle trackers are invaluable tools for monitoring either a single car or an entire fleet of vehicles. Kalman filter is used for vehicle tracking that give greater accuracy in estimating the position of vehicle by considering the initial state of the system.

Key words: GPS (Global Positioning System), Kalman filter, Error covariance, Measurement noise, Vehicle Tracking System.

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INTRODUCTION OF GLOBAL POSITIONING SYSTEM:

Global Positioning System (GPS) is a worldwide radio-navigation system formed by a constellation of 24 or more satellites, several ground stations, and millions of users like you. These system segments—space, ground, and user—work together to provide accurate positions any time, anywhere in the world.

The Space Segment: The space segment is a constellation of 24 satellites in precise, nearly circular orbits about 20,200 kilometers (km) above the earth. They are designated as "spares" but are fully operational. The satellites are arranged in six orbital planes. Each plane is tilted at 55 degrees relative to the equator, to provide polar coverage. Each satellite orbits the earth twice a day. GPS receiver requires signals from at least four satellites in order to determine its location Rain, fog and snow have no effect on these signals, making GPS an all-weather system.

The Control Segment: The Control Segment includes 12 ground stations. The monitor stations track the navigation signals from all the satellites and continuously send the data to the Master Control Station (MCS) for processing.

The User Segment: the whole GPS system exists to tell you where you are right now. It does that very well—and for free! But remember that it's a dual-use system, which means that it is intended for use by both military and civilian applications. So to be realistic about it, there are two distinct user segments:

■ Military users can employ special system capabilities and have a very different list of applications than the rest of us.

■ Civilians, like you and me, generally want to use the positioning and timing capabilities for everyday activities. This is the user segment for which this book is written[1].

Applications: Where GPS is Used

- Personal Navigation
- Aviation Navigation
- Vehicle Navigation

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- Marine Navigation
- Agriculture
- Mapping and GIS
- Construction
- Public Safety
- Timing & Synchronization

GPS TRACKING SYSTEM:

A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a vehicle, person, or other asset to which it is attached and to record the position of the asset at regular intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location data base, or internet-connected computer. The Vehicle tracking system is a the tracking device which is generally operated by GPS is attached with the vehicle. satellite signals is first received by it and then it determines its position co-ordinates with latitude and longitude. These coordinates are generally observed on a computer screen and by using mapping software we can see the exact position of our vehicle. generally vehicle tracking technology user can access the information of a vehicle based on vehicle's position, speed and distance traveled and duration of each stoppage with a central operating center by entering the mobile number of user through mobile phones or websites using SMS or Internet. Vehicle tracking technology is advantageous for tracking and monitoring both commercial and passenger vehicle. As concerned with personal vehicle tracking, it allows recovering our stolen vehicle by pin pointing that gives the exact location.[2]

TYPES OF GPS TRACKING SYSTEM

Three Types of GPS Tracking Units are there:

1. Data Loggers: Data loggers are usually the most basic type of GPS tracking; a GPS data logger simply logs the position of the object at regular intervals and retains it in an internal memory. Usually, GPS loggers have flash memory on board to record data that is logged. The

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flash memory can then be transferred and accessed using USB or accessed on the device itself. Usually data loggers are devices used for sports and hobby activities. They might include devices that help log location for hikers, bikers and joggers.

2. Data Pushers: Data Pushers are GPS tracking units that are mainly used for security purposes. A data pusher GPS tracking unit sends data from the device to a central database at regular intervals, updating location, direction, speed and distance. Data pushers are common in fleet control to manage trucks and other vehicles.

3. Data Pullers: The last category of GPS tracking units is the data pusher units. These types of units push data or send data when the unit reach a specific location or at specific intervals. These GPS units are usually always on and constantly monitoring their location. [3]Most, if not all data puller unit also allow data pushing (the ability to query a location and other data from a GPS tracking unit)

Application of the GPS tracking system:

- Fleet control
- Stolen vehicle searching
- Animal control
- Espionage/surveillance
- Race control
- Internet Fun Sport

KALMAN FILTER: Kalman filter is a mathematical toolbox that are used for estimation in the sense that it minimizes the estimated error covariance – when some presumed condition met. Kalman filtering is based on the linear mean square error filtering that implement a Predictor-corrector type estimator and estimate from the noisy sensor measurement.[3].

The Kalman filter us named after Rudolph E. Kalman ,who in 1960 published his famous paper describing a recursive solution to the discrete-data linear filtering problem. Since the time of its

introduction, the Kalman filter has been the subject of extensive research and application used in the area of autonomous or assisted navigation[4]

KALMAN FILTER ALGORITHM:

The Kalman filter [5] is a method that can be used for combining a model of a system with a set of noisy sensor measurements to produce an estimate of the underlying state, such as the position. The method is divided into two steps, the time update and the measurement update. In the time update, a motion model is used to predict the future state of the system. The measurement update then produces a new corrected estimate, by combining the prediction with the sensor measurements. The first application of the Kalman filter was by Stanley Schmidt for trajectory estimation in the Apollo program. [6]

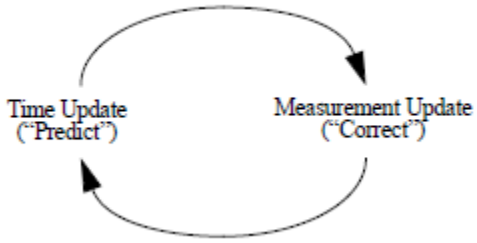

Figure 1. The ongoing discrete Kalman filter cycle.

The time update projects the current state estimate ahead in time. The measurement update adjusts the projected estimate by an actual measurement at that time. The time update equations are responsible for projecting forward (in time) the current state and error covariance estimates to obtain the a priori estimates for the next time step. The measurement update equations are responsible for the feedback—i.e. for incorporating a new measurement into the a priori estimate to obtain an improved a posteriori estimate [7]. The time update equations can also be thought of as predictor equations, while the measurement update equations can be thought of as corrector equations. Indeed the final estimation algorithm resembles that of a predictor-corrector algorithm for solving numerical problems as shown above in Figure 1.

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After each time and measurement update pair, the process is repeated with the previous a posteriori estimates used to project or predict the new a priori estimates. This recursive nature is one of the very appealing features of the Kalman filter—it makes practical implementations much more feasible than (for example) an implementation of a Weiner filter [Brown92] which is designed to operate on all of the data directly for each estimate. The Kalman filter instead recursively conditions the current estimate on all of the past measurements.

Application of kalman filter

- Aerospace
- Marine Navigation
- Nuclear Power Plant
- Navigation and Control of Vehicles
- Aircraft and Spacecraft
- Signal Processing and Econometrics.

CONCLUSION

GPS vehicle tracking is a modern technologies that are used to know the exact location of the vehicle and alert the user so that the user can stop the vehicle by sending SMS. The users can easily identity the location of the theft vehicle which in turns saves the money and time. In this paper we describe the kalman filter that filter the vehicle position and inform the user about the location of vehicle in form of longitude, latitude . With the help of these information user find out the vehicle. This system is user friendly, easily installable, easily accessible and can be used for various other purposes.

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REFERENCES

[1]. TRIMBLE," GPS- The First Global Satellite Navigation system in 2007.

[2]. Mrs. K.P.Kamble, Department of Electronics and Telecommunication Engineering, YCCE, Nagpur, SMART VEHICLE TRACKING SYSTEM (IJDPS) Vol.3, No.4, July 2012

[3]. Bonrix Software Systems, Introduction To GPS Based Vehicle and Person Tracking System

[4]. Kaplan E (ed), (1996), Understanding GPS:Principles and Applications, 1st edition (Boston: Artech House).

[5]. Greg Welch, Gary Bishop, "An Introduction to the Kalman Filter", Department of Computer Science University of North Carolina at Chapel Hill Chapel Hill, NC 27599-3175

[6]. R. E. Kalman, "A new approach to linear filtering and prediction problems," Transactions of the ASME - Journal of Basic Engineering, vol. 82, no. Series D, pp. 35–45, 1960.

[7]. L. A. McGee and S. F. Schmidt, "Discovery of the kalman filter as a practical tool for aerospace and industry," National Aeronautics and Space Administration Report NASA-TM-86847,1985.

[8]. Peter S. Maybeck, "The Kalman Filter: An Introduction to Concepts," in Autonomous Robot Vehciles, I.J. Cox, G. T.Wilfong (eds), Springer-Verlag, 1990.

