Vehicle Navigation Based on Geographic Position System and Remote Sensing for Backward or Rural Environment

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Abstract—- Navigation is a field of study that focuses on the process of monitoring and controlling the movement of a craft or vehicle during its journey from one place to another. A Geographic Information System (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. By using GPS and Remote sensing we can navigate vehicle in rural area there are no any road and train track.

Keywords: - Navigation System, GIS, GPS and Remote Sensing.

I. Introduction

GPS is a space-based positioning, navigation, and timing system developed by the U.S. Department of Defence (DoD). It was emerged in 1960s and 1970s as a merger of synergistic Navy and Air Force programs for timing and space-based navigation, respectively. The U.S. Air Force, currently, finances and operates the basic system of 24 satellites and associated ground monitoring stations located around the world. GPS is widely characterized as a satellite navigation or a satellite positioning system that provides signals for geo-location and for safe and efficient movement, measurement, and tracking of people, vehicles, and other objects anywhere from the earth's surface to geosynchronous orbit in space [1]. A less-known element omitted from many GPS descriptions is the embedded timing that serves an essential role in its navigation services. The precise time and stable frequency signals available from GPS are at least equal in importance to its navigation and velocity determination functions. They serve as synchronization sources for global communications, electronic transactions of all types, power-distribution networks, and innumerable other applications. From its beginning, the GPS architecture was designed to minimize military navigation and timing vulnerability by moving the vital electronic processing and transmitting equipment into space to make them extremely difficult to reach. From there, GPS signals provide a multimission force multiplier service for an unlimited number of U.S. and allied military users. Though many believe civil applications only came along much later, in fact, GPS scope was expanded early in its development to include complementary civil capabilities as GPS implements a time-difference-of-arrival concept using precise satellite position and on-board atomic clocks to generate navigation messages that are continuously broadcast from each of the GPS satellites. These messages can be received and processed by users anywhere in the world to determine position and time accurate to within a few meters and a few nanoseconds, respectively. Each GPS satellite on-board computer and navigation message generator knows its own orbital location and system time very precisely. A global network of monitor stations carefully keeps track of these parameters. Corrections are uploaded to each satellite at least daily by the world wide operational control system with Master Control Station at Schriever Air Force Base, Colorado Springs, CO [Fig 1].

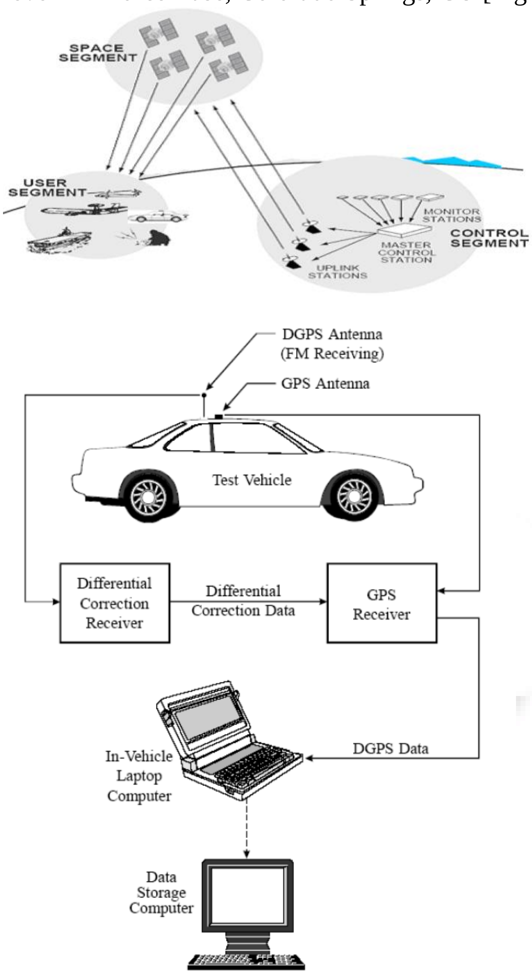

Fig. 1: Basic Segments of GPS

The uploads include orbit position projections for each satellite in the constellation, based on sophisticated models and effective for several weeks, as well as corrections to on-board satellite clocks. System time is maintained aboard each satellite by Cesium and Rubidium atomic frequency standards. In general, these on-board clocks are accurate to within a few nanoseconds of global coordinated time (UTC) as maintained by the Master Clock at the U.S. Naval Observatory (USNO) and are individual or better. Early GPS satellites ally stable to a few parts in 10 contain two Cesium and two Rubidium standards each, later versions have all Rubidium standards. Only one standard is operational aboard each satellite at any given time.

II. Application Of GPS

The basic complement of GPS services has changed relatively little since program inception, and GPS has emerged as 647 the quintessential dual-use system, which is of enormous benefit to myriad military, civil, commercial, and scientific users around the world. This multiplicity of uses pervades almost every aspect of GPS activity and provides the stimulus for its future improvement. Unfortunately, this diversity also acts against the system in its competition for resources.

A. Telecommunication

Global timing and communications infrastructures have quietly adopted GPS as the primary distribution mechanism for time and frequency synchronization. The USNO serves as the nation's timekeeper and is by far the major contributor to the global timing standard Universal Coordinated Time (UTC). As a part of its mission, the USNO maintains its alternate Master Clock at the GPS Master Control Station and provides the data necessary to steer GPS time directly to the USNO standard.

B. Electrical Power Distribution

Nationwide, many electric power companies have begun to use GPS timing and frequency services to improve the economy and efficiency of their operations. They primarily use GPS signals for monitoring stability of line frequencies, frequency synchronizing, or "syntonizing" services with adjacent power company networks, and isolating faults in their own transmission networks. The fidelity of service provided by GPS far exceeds the routine needs of power companies, but its ready free availability makes it very appealing, and the precise timing signal is useful in isolating damage in remote lines to within a single tower span.

C. Transportation

GPS was viewed with some skepticism by the civilian transportation agencies through which it was intended to replace long-standing ground-based radio navigation aids. As it reached operational status in the early 1990s, however, its consistently high-quality performance and low cost of use created a dramatic shift in planning, as reflected in the Federal Radionavigation Plan. Two U.S. Department of Transportation (DoT) modal agencies, the U.S. Coast Guard and the FAA, initiated programs to augment GPS accuracy. The Coast Guard initially began with an differential augmentation service to provide sub-10-m accuracy around the contiguous U.S. (Maine–Texas and California–Alaska), the Great Lakes and St. Lawrence Seaway, and the Mississippi and Missouri River watersheds using marine radio beacons. That service is now fully operational and actually operates at a precision of 1–2 m. In the aftermath of the Exxon Valdez accident, it has been officially (Act of Congress and Coast Guard regulation) added to the carriage requirements for oil tankers operating in proximity to land. The service has also been expanded to interior land applications in the last couple of years in a cooperative venture with the Federal Railroad Ad-ministration and the Air Force called Nationwide Differential GPS (NDGPS).

D. Emergency Services

Closely related to GPS contributions to both communications and transportation are its contributions to the emergency services infrastructure of police, fire, and ambulance providers. Use of GPS is growing significantly among regional ambulance providers as a means of managing fleets of emergency vehicles. As its use increases in automobiles, it is becoming a significant factor in 911-type situations, where emergency vehicles are dispatched to accident locations by activation of a GPS location keyed to activation of an air bag. Further, GPS-derived positions are now being included in planning for E-911 capabilities required by legislation from cellular telephone service providers. GPS has also proven its value to fire departments operating in devastated parts of the California hills after the Oakland fire of several years ago, to the diverse government emergency response teams dealing with the aftermath of Hurricane Andrew in south Florida and with flooding in the mid west. While GPS use is growing rapidly in this sector, it has not yet reached the point of reliance, though incorporation in E-911 situations will dramatically increase its importance in the future.

E. Military

Militarily, GPS provides an unparalleled force-enhancement tool. It is unique in its ability to establish an unambiguous correlation in four dimensions between a target and a dynamic weapon system aimed at that target—all the time, anywhere on the earth, and under any conditions of light, weather, or other source of target obscuration. Further, since it requires no electronic transmissions for access, it enables safe, efficient, and precise operations in situations where complete radio silence is required. Due to those performance features, both the DOD and Congress have mandated GPS for military operations.

F. Financing and Politics

We might expect that these market projections, along with the technology base and infrastructure dependencies already identified, would be sufficient to stimulate long-term policy and financial support from the U.S. government. However, now that GPS has achieved its initial quiet success, its stewards must now contend with the relatively thankless, but critical, long-term struggle of maintaining and improving the system as a component of the national utility infrastructure. As such, GPS must compete continually for resources with glamorous new technologies that promise equally revolutionary results. At question is whether the framework that stimulated its initial success will be sufficiently robust to sustain and strengthen the evolution of the GPS utility into the future.

G. Frequency Spectrum And Politics

The radio-frequency spectrum access issues facing GPS are both technically and politically complicated. By design, GPS operates at extremely low power, making it susceptible to certain kinds of interference if frequency spectrum use is not carefully controlled. GPS signals are transmitted in portions of the RF spectrum that are also very popular and in high demand for satel- lite communications services that generally produce the kind of interference most harmful to GPS. Although GPS and communications services are quite syner-gistic in their applications, they are incompatible in their use of spectrum. GPS suffers from a tremendous disadvantage because of its low signal power. Some satellite communications service providers have already sought approval through the national and international regulatory processes for their signals to encroach on the GPS spectrum allocation, placing the viability and utility of GPS signals at serious risk. For technical reasons, moving the GPS signals or significantly boosting power from the satellites are not options.

III. LITERATURE SURVEY

A lot of works have been done on geographical positioning system specially for vehicle navigation system and vehicle tracking applications.

A. Uninterrupted Portable Car Navigation System

Davidson et al. [2] present the development of car navigation system for portable navigation devices and car telematics applications. The objective was to develop a system that can provide uninterrupted reliable navigation even when GPS signals are not available. The approach uses digital maps, 3D accelerometer and one gyro for directional measurements to improve positioning availability and reliability in weak signal environment and during short GPS signal outages. This system does not require vehicle installation and can be easily transferred between vehicles. Loosely coupled extended Kalman filter and probabilistic map-matching algorithm provide optimally tuned navigation solution and continuous auto calibration of inertial sensors. A real-time prototype was built. The system accuracy performance was investigated using field tests in an urban environment Accurate and uninterrupted position calculation is a key task for vehicle navigation and telematics applications. In most portable car navigation and telematics devices the position is calculated based only on GPS data. However, in urban canyons stand-alone GPS suffers signal masking and reflections of the signal from buildings, large vehicles, and other reflective surfaces. Driving tests in such metropolises as Hong Kong, Tokyo, and New York show that the chance of receiving four GPS satellites required for navigation can be as low as twenty percent of total driving time [3].

B. Automatic Map Scaling in Car Navigation Systems

Sheleiby et al. [4] proposes that in order to achieve the mentioned aim, context -aware computing should be utilized. Context -aware computing is a computing paradigm that enables systems to acquire current user's context s and adapt their behavior accordingly. In this paper, the context -awareness potential for presenting maps with various scales which adapted to users context s is evaluated. Also various contexts that may have an impact on map scale are studied and then an approach to select proper scale in these contexts is proposed.

C. Modelling Turning Restrictions In Traffic Network

Jiang et al. [5] have discussed firstly the properties of the turning restrictions in road networks. The model in conceptual model (GDF 4.0) and logical model (UNETRANS) were introduced. Concerning the algorithmic model, the authors analyzed the disadvantages of the commonly used data structure for representing the turning restrictions. And proposed a new link-based data structure, where a node-link table is used to represent the connectivity of the road network, and a link-link table is used to represent the turning restrictions. The algorithm for route finding was also modified accordingly. The results of the experiment show that the efficiency of route finding is obviously improved with the new method.

IV. NEED OF STUDY

Several real-time situations where geographical navigation system is needed. Some of them are given below.

A. Vehicle Navigation System

To navigate the positions of vehicle provides help and guidance to persons for reach unknown and unaware locations or place. Navigation also help us to analyze the traffic load. It enables us to visit anywhere without worry of any uncertainness which is connected to road track.

B. Agriculture and Farming

Tractor Guidance- Farmers cannot put their tractors on autopilot. If they plough their fields with a recording GPS system, the tractor can be programmed to follow the same route – for cultivating, fertilizing, pest control, and harvesting. The programming of tractor routes greatly reduces farming costs.

Crop-duster Targeting- A crop-duster is a light airplane equipped for spraying crops with powdered insecticides and/or fungicides. Insects and fungi do not just attack a field according to a uniform distribution. Instead, they concentrate their attack on certain areas. Workers, strolling along the crops, can use a GPS to record the locations of insect and fungi problems. Instead of treating an entire field, the data can then be used by crop-duster pilots to selectively target the problem areas. This method results in a savings of time, fuel, insecticide, fungicide, and crop exposure to chemicals.

Tracking Livestock- The location of valuable animals on a large farm can be monitored by GPS transmitters attached to the animal's collar. When the animals are sent to the market, GPS transmitters can also be used to track their location.

Yield Monitoring- Estimates of yield variations across a property can be made using GPS. To do this, the property is divided into zones and the yield of each zone is estimated. During harvest, a GPS receiver is mounted on the harvesting machine. As the harvesting is being done on each zone, the yield is recorded and the GPS receiver determines the location of the zone. This information (yield and zone) is plotted on a map. The map can then be used to better understand the properties of the earth and for decision-making with regard to the next planting.

Soil Sampling-Collecting soil samples across a large area can be organized using GPS and mapping software. The sample locations can be way-pointed in the field and those waypoints are marked on the mapping software. Then, when the laboratory results are returned, the data can be plotted on the maps and decisions for soil treatment can be made for various parts of the property. This location information can save money and time by allowing variable rate applications and treating only those areas with a documented need.

C. Aviation Safety

Aviation safety refers to the efforts that are taken to ensure that airplanes are free from factors that may lead to injury or loss. Of course, airplanes always have to be safe. If not, the manufacturer would not be in business for long. In order to make airlines safer, commercial airlines are working on new techniques called Radio Navigation (RNAV) and Required Navigation Performance (RNP) [6]. These techniques use

GPS technology [7] to improve approach and landing precision at airports that have limited ground-based navigation equipment [8]. With RNAV/RNP procedures, airlines can easily and effectively land in remote airports that often get socked in by stormy weather. The number of airlines that use GPS has increased over the years.

D. Tracking Convicted/Suspected Criminals

GPS bracelets can be placed on selected felons on parole to monitor their movements. For example, the system could monitor if criminals are staying away from the homes of their victims, are traveling to work each day, or are going near to schools. Such systems can be used to verify that certain restraining orders are being obeyed. GPS units have also been used to record and monitor the movements of crime suspects. Use of such information to aid in a conviction or an investigation has been challenged by defendants as an infringement of their privacy.

E. Online Crime Maps

Police departments in many densely populated cities use GPS to feed data into an online Geographical Information System (GIS). This online GIS allows the police to effectively create maps of the locations of different categories of crimes, which occur over a given period of time within a particular city. With this information, the public is kept well informed. A clear example could be seen in some neighborhoods of Amsterdam with messages such as “Beware of pickpockets,” in the Center of Amsterdam or “Use it, Lose it,” in some parts of Amsterdam Zuid-Oost (South East) to indicate that you could lose your mobile phone to a thief upon using it.

F. Appealing Speed Tickets

A few individuals cited for speeding have produced GPS tracking information from their on-board GPS to appeal their ticket. Causes for this error could be that the police officer stopped the wrong car or his radar was malfunctioning.

G. Bicycle Racing

Ten riders in the 2004 Tour de France were equipped with GPS transmitters. This provided their location and speed at all times. In future years, all riders could be equipped with GPS and the progress of the race could be tracked on maps and topographic profiles could be made.

H. Athletic Training

Runners, cyclists, skiers, and other athletes who race across landscapes can use tiny GPS units while training to monitor their speed, distance covered, course difficulty, and more. Combined with a recording heart rate monitor the GPS units can provide valuable information about an athlete's condition and can be used to develop racing strategies as well.

V. RESEARCH METHODOLOGY

To achieve the required goal in the form of developed detecting or tracking moving objects application for backward area, the methods and system are required for application described below:

A. System Required

For the implementation and for execute the program required the system configuration as given below.

- *Processor*
  PC with 2.6 GHz Pentium IV processor
- *RAM*
  512 MB
- *Available Hard Disk Space*
  600 MB on system drive, 3 GB installation drive
- *Operating System*
  Linux, Windows XP

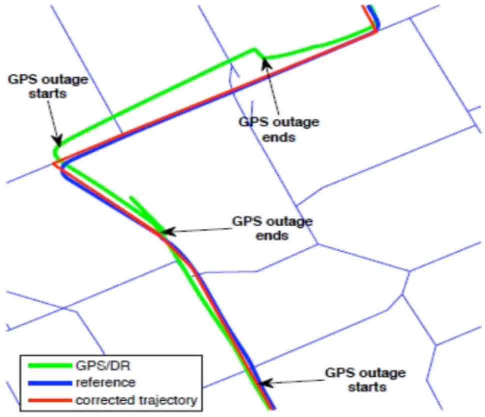

Fig. 2: Path Tracking

Flow-Chart

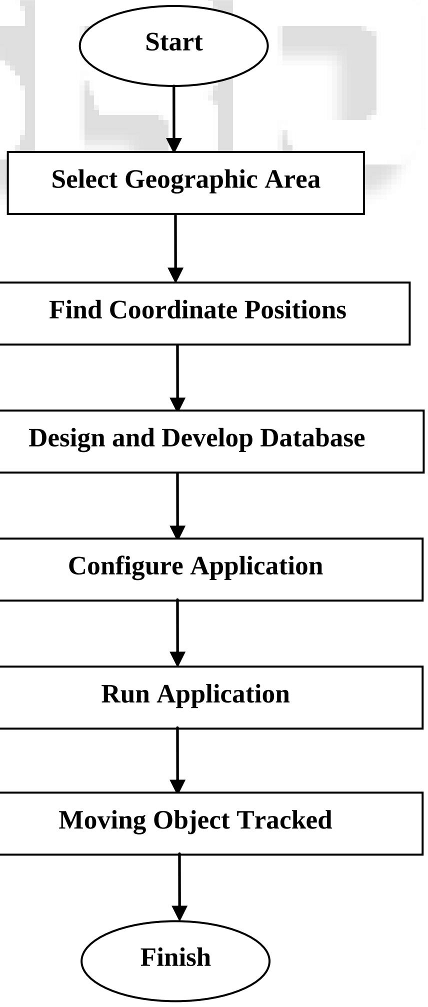

Fig. 3:

Addition with this some design and analysis is described. In the below figure the blue line is a DGPS computed trajectory which is a reference trajectory in our case. The position error of Novatel DGPS receiver didn't exceed 0.5 m during the test. The green line is the GPS/DR integrated solution. During GPS outages it will be the DR only solution. The red line corresponds to a corrected solution after map-matching algorithm was applied.

VI. CONCLUSIONS

We have developed computer based navigation system for backward and rural environment. It creates navigation rules for hilly TERRAIN. We can also navigate using GIS, GPS and Remote Sensing

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