ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Entity Tracking and Surveillance using the Modified GPS-3 System

C.Shanthosh[*1], Varun[2]

[*1,2]Electronics and Communication Engineering Department, Sri Sairam Institute of Technology, Sai Leo Nagar, West Tambaram, Chennai – 600 044, Tamilnadu, India

shanthosh.chandramouli@gmail.com

Abstract

Identification of exact enemy location is extremely necessary in modern military warfare. The variants of enemy target are either fixed location like building or training site etc. or a moving vehicle carrying ammunition or persons. In either case, locating the initial position becomes mandatory. Global Positioning System (GPS) comprising of satellites, computers and receivers are able to determine the latitude and longitude of a target on earth. A novel GPS-3 system is suggested in this paper for accurate location identification of enemy targets (fixed or moving) enabling improved command and control of military operations.

Keywords: Triangulation, GPS, Electromagnetic spectrum, Wireless communication, AEL system, GPS-3

Introduction

A system of satellites, computers, and receivers is incorporated that determines the latitude and longitude of an object which can be done by calculating the time difference between the signals from the Global Positioning different satellites to reach the receiver. GPS System is a worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations. GPS uses these "man-made stars" as reference points to calculate positions accurate to a matter of centimetres. In fact, with advanced forms of GPS it is possible to make measurements to better than a centimetre. In a sense it's like giving every square metre on the planet a unique address. Though the GPS is used in many applications, it is extensively used in military operations for Automatic Entity Location (AEL) of enemy targets, moving or stationary.

Technology Requirements

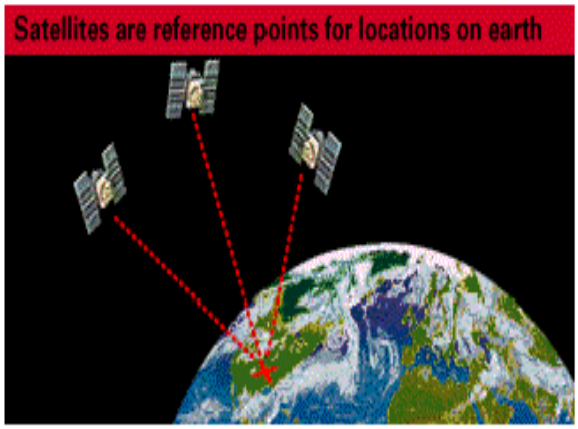
The system consists of a "constellation" of at least 24 satellites in 6 orbital planes. Each satellite circles the Earth twice every day at an altitude of 20,200 kilometers (12,600 miles). The satellites carry atomic clocks and constantly broadcast the precise time according to their own clock, along with administrative information including the Orbital elements of their own motion, as determined by a set of ground-based observatories.

The receiver does not need a precise clock, but does need to have a clock with good short-term stability and receive signals from four satellites in order to find its own latitude, longitude, elevation, and the precise time. The receiver computes the distance to each of the four satellites from the difference between local time and the time the satellite signals were sent (this distance is called a pseudo range). It then decodes the satellites' locations from their radio signals and an internal database. The receiver should now be located at the intersection of four spheres, one around each satellite, with a radius equal to the time delay between the satellite and the receiver multiplied by the speed of the radio signals. The receiver does not have a very precise clock and thus cannot know the time delays. However, it can measure with high precision the differences between the times when the various messages were received. This yields 3 hyperboloids of revolution of two sheets, whose intersection point gives the precise location of the receiver. This is why at least four satellites are needed: fewer than 4 satellites yield 2 hyperboloids, whose intersection is a curve; it is impossible to know where the receiver is located along the curve without supplemental information, such as elevation. If elevation information is already known, only signals from three satellites are needed (the point is then defined as the intersection of two hyperboloids and an ellipsoid representing the Earth at this altitude). The receiver contains a mathematical model to account for these influences, and the satellites also broadcast some related information, which helps the receiver in estimating the correct speed of propagation. High-end receiver /antenna systems make use of both L1 and L2 frequencies to aid in the determination of atmospheric delays.

ISSN: 2277-9655
Impact Factor: 1.852

The Theory of Triangularity

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location.



Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. This delay is calculated, and the length of the delay tells the signal's travel time. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map. A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset.

Triangulating principles

- Position is calculated from distance measurements (ranges) to satellites.
- Mathematically we need four satellite ranges to determine exact position.

Several frequencies make up the GPS Electromagnetic spectrum:

- L1 (1575.42MHz): Caries a publicly usable coarse acquisition C/A) code as well as an encrypted position P (Y) code.
- L2 (1227.60MHz): Usually carries only the P(Y) code. The encryption keys required to directly use the P(Y) code are tightly controlled by the U.S. Government and are generally provided only for military use. The keys are changed on a daily basis. In spite of not having the P (Y) code encryption key, several high-end GPS receiver manufacturers have developed techniques for utilizing this signal (in a round-about manner) to increase accuracy and remove error caused by the ionosphere.
- L3 (1381.05MHz): Carries the signal for the GPS constellation's alternative role of detecting missile/rocket launches (supplementing Defense Support Program satellites), nuclear detonations, and other high-energy infrared events.
- L4 (1841.40MHz): Being studied for additional ionospheric correction.
- L5 (1176.45MHz): Proposed for use as a civilian safety-of-life signal.

Proposed Automatic Entity Location (AEL) System

The AEL tracking system consists of a GPS receiver inside the GPS-3 and a communication link between the entity and the control center as well as PC-based tracking software for dispatch. The AEL now continuously tracks the position of the target. In addition to the position identification the data received is now fed to a map which helps in the tracking of the target from the base station. The communication system is usually a cellular network similar to the one used by a cellular phone. This AEL system not only provides tracking and route finder to target, a spy cam is provided which gives us live visuals which are studied from the base station. Also a microphone is embeded to it which helps us to make out what the target (human) is communicating.

GPS - 3

A GPS-3 gets its name as such because of it's 3 functional elements

- Conventional GPS
- Microphone
- Spy cam

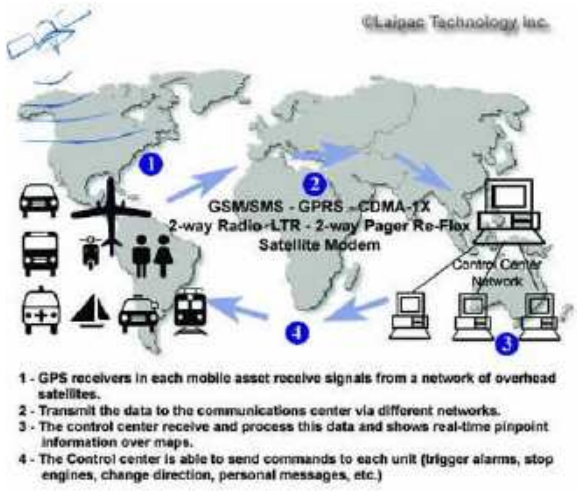
The mic helps in transmitting the surrounding or the target's voice (human) continuously to the receiving monitoring system and the camera relays live coverage to the receiving system. The total control is placed only with the base station.

GPS Segments

The GPS system is divided into three segments:

- Space - GPS satellites
- Control - Ground Station
- User - GPS receivers

ISSN: 2277-9655
Impact Factor: 1.852



Conclusion

The GPS-3 enabled AEL system has an advantage over the traditional Biometric system as biometric system injects foreign material inside the body which may cause harm. Nowadays GPS receivers are becoming very economical and that makes the technology accessible to virtually everyone. The GPS location data is stored on board of the GPS receiver. An improved GPS system (GPS-3) is proposed with an inbuilt microphone and camera. The system employs the triangulation concept to identify exact location interconnected with e-map connectivity and the camera operation which enables the experience of exact video visuals of the target which can easily be viewed on an android based mobile or a laptop. Microphone and voice synthesizing circuits enables audio information surrounding the target.

This 3 in 1 system, when used for military purposes, enables not only detection and movement of the enemy position but also their strategy as heard by voice signals.

References

[1] Kelly J, Bogensberger E, Heitz S, Beckman K, Emery J, Rambo J, 2001, Development of the first Military GPS Handheld Survey System: Initial Report. Rockwell Collins Government Systems USA..
[2] Dennis Roddy, , *"Satellite Communications",McGraw Hill*, Jan. 2006.
[3] http://www.landairsea.com/gps-tracking-blog/gps-tracking-military-applications/
[4] http://forums.military.com/eve/forums/a/tpc/f/65819558/m/3330059461001
[5] http://www.gisdevelopment.net/technology/gps/techgp0048.htm