GLOBAL POSITIONING SYSTEM DATA LOGGER

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Abstract:-

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, using a cellular (GPRS or SMS), radio, or satellite modem embedded in the unit. This allows the asset's location to be displayed against a map backdrop either in real time or when analysing the track later, using GPS tracking software.

Keywords:- GPS, Tracking architecture, Type-Data logger, data pusher, data puller.

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I. INTRODUCTION:

What is GPS:-

The Global Positioning System (GPS) is a location system based on a constellation of about 24 satellites orbiting the earth at altitudes of approximately 11,000 miles. GPS was developed by the United States Department of Defense (DOD), for its tremendous application as a military locating utility. The DOD's investment in GPS is immense. Billions and billions of dollars have been invested in creating this technology for military uses. However, over the past several years, GPS has proven to be a useful tool in non-military mapping applications as well.

GPS satellites are orbited high enough to avoid the problems associated with land based systems, yet can provide accurate positioning 24 hours a day, anywhere in the world. Uncorrected positions determined from GPS satellite signals produce accuracies in the range of 50 to 100 meters. When using a technique called differential correction, users can get positions accurate to within 5 meters or less.

Today, many industries are leveraging off the DOD's massive undertaking. As GPS units are becoming smaller and less expensive, there are an expanding number of applications for GPS. In transportation applications, GPS assists pilots and drivers in pinpointing their locations and avoiding collisions. Farmers can use GPS to guide equipment and control accurate distribution of fertilizers and other chemicals. Recreationally, GPS is used for providing accurate locations and as a navigation tool for hikers, hunters and boaters.

Many would argue that GPS has found its greatest utility in the field of Geographic Information Systems (GIS). With some consideration for error, GPS can provide any point on earth with a unique address (its precise location). A GIS is basically a descriptive database of the earth (or a specific part of the earth). GPS tells you that you are at point X,Y,Z while GIS tells you that X,Y,Z is an oak tree, or a spot in a stream with a pH level of 5.4. GPS tells us the "where". GIS tells us the "what". GPS/GIS is reshaping the way we locate, organize, analyze and map our resources.

GPS tracking unit

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, using a cellular(GPRS or SMS),radio, or satellite modem embedded in the unit. This allows the asset's location to be displayed against a map backdrop either in real time or when analysing the track later, using GPS tracking software.

A GPS tracker essentially contains GPS module to receive the GPS signal and calculate the coordinates. For data loggers it contains large memory to store the coordinates, data pushers additionally contains the GSM/GPRS modem to transmit this information to a central computer either via SMS or via GPRS in form of IP packets. The diagram depicts a hardware architecture of an advanced GPS tracker.

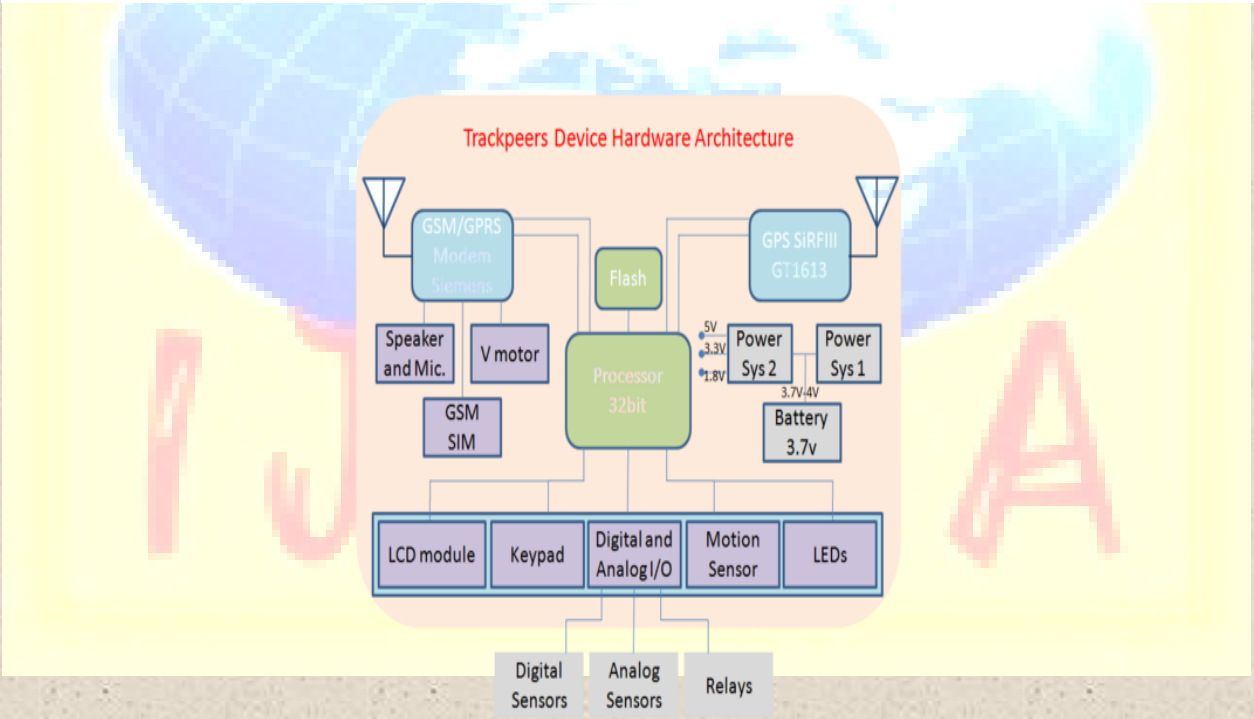


Fig 1: GPS tracker architecture

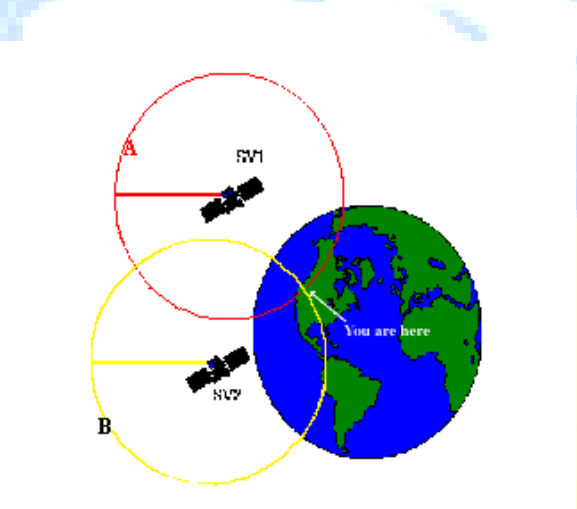
How GPS Determines a Location:-

Now we will consider example, person who exactly 12 miles away from the ABC Grocery Store. Now you can define a second sphere with its origin at the store and a radius of 12 miles. You know that the person located somewhere in the space where the perimeters of these two spheres intersect - but there are still many possibilities to define his location.

Adding additional spheres will further reduce the number of possible locations. In fact, a third origin and distance (A person tell you his 8 miles away from the City Clock) narrows his position down to just 2 points. By adding one more sphere, you can pinpoint his exact location. Actually, the 4th sphere may not be necessary. One of the possibilities may not make sense, and therefore can be eliminated.

For example, if you know a person above sea level, you can reject a point that has negative elevation. Mathematics and computers allow us to determine the correct point with only 3 satellites.

Based on this example, you can see that you need to know the following information in order to compute your position:



A) What is the precise location of three or more known points (GPS satellites)?
B) What is the distance between the known points and the position of the GPS receiver?

How the Current Locations of GPS Satellites are Determined:-

GPS satellites are orbiting the Earth at an altitude of 11,000 miles. The DOD can predict the paths of the satellites vs. time with great accuracy. Furthermore, the satellites can be periodically adjusted by huge land-based radar systems. Therefore, the orbits, and thus the locations of the satellites, are known in advance. Today's GPS receivers store this orbit information for all of the GPS satellites in what is known as an **almanac**. Think of the almanac as a "bus schedule" advising you of where each satellite will be at a particular time. Each GPS satellite continually broadcasts the almanac. Your GPS receiver will automatically collect this information and store it for future reference.

The Department of Defense constantly monitors the orbit of the satellites looking for deviations from predicted values. Any deviations (caused by natural atmospheric phenomenon such as gravity), are known as **ephemeris** errors. When ephemeris errors are determined to exist for a satellite, the errors are sent back up to that satellite, which in turn broadcasts the errors as part of the standard message, supplying this information to the GPS receivers.

By using the information from the almanac in conjuction with the ephemeris error data, the position of a GPS satellite can be very precisely determined for a given time.

II. Types of GPS trackers:

GPS tracking units are divided into three categories, based on the techniques of data logging and retrieval.

Data Loggers:-

A GPS data logger logs the position of the object at regular intervals and stores the information in flash-based memory. Data on the memory can be retrieved or transferred to other stores with the help of available USB connectivity. Such devices are suitable for long distance hickers and cycling enthusiasts,who can make use of the logging facility to chalk out future routes to be followed.

Data Pushers:-

The GPS data pushers are popular for security purpose. This unit send data from the device to a central database at regular intervals,updating information on location, direction,speed and distance.

Such devices are suited for monitoring fleets of trucks and delivery vehicles. Vehicles can be located instantly in order to carry out effective supervision and prevent theft.

Since it is easy to track movements of individuals or vahecles carry valuable items,GPS data pushers are often used for spying.

Data Pullers:-

A GPS data puller allows the user to 'pull' data from the receiver as frequently as needed.The device remains on at all times.Thought it is not as commonly used as the pusher device,it is particularly useful for tracing stolen goods.A mobile phone with integrated GPS can reply to an SMS from the data puller.This technology finds use in situations where tracking is required to be done only rarely.

What Is a Data Logger:-

Data logging and recording is a common measurement application. In its most basic form, data logging is the measuring and recording of physical or electrical parameters over a period of time. The data can be temperature, strain, displacement, flow, pressure, voltage, current, resistance, power, and many other parameters. A wide range of products can be categorized as data loggers, from basic devices that perform a single measurement to more complex devices that offer analysis functions and integrated displays. Many applications are more involved than just acquiring and recording signals, sometimes involving a combination of online analysis, offline analysis, display, report generation, and data sharing. Moreover, applications are beginning to require the acquisition and storage of other types of data, such as recording sound and video in conjunction with the other parameters measured during an automobile crash test.

Figure 2. Data loggers can be both PC-based or stand-alone devices**.**

Data logging is used in a broad spectrum of applications. Chemists record data such as temperature, pH, and pressure when performing experiments in a lab. Design engineers log performance parameters such as vibration, temperature, and battery level to evaluate product designs. Civil engineers record strain and load on bridges over time to evaluate safety. Geologists use data logging to determine mineral formations when drilling for oil. Breweries log the conditions of their storage and brewing facilities to maintain quality. The list of applications for data logging goes on and on, but all of these applications have similar common requirements.

How Does a Data Logger Work:-

A data logger works with sensors to convert physical phenomena and stimuli into electronic signals such as voltage or current. These electronic signals are then converted or digitized into binary data. The binary data is then easily analyzed by software and stored on a PC hard drive or on other storage media such as memory cards and CDs.

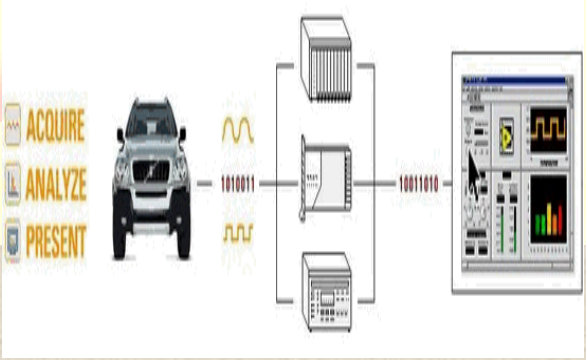


Figure 3. How does a data logger work

A few components that every data logger must have include:

Follow these steps when using a data logger:

- Hardware to digitize what you are logging, including sensors, signal conditioning, and analog-to-digital conversion hardware
- Long term data storage,typically onboard memory or a PC
- Data-logging software for data acquisition, analysis, and presentation

Follow these steps when using a data logger:

- Connect sensors like thermocouples, resistance temperature detectors (RTDs), thermistors, strain gages, and accelerometers to the data logger
- Use your data-logging software to configure your data logger
- Configure parameters like sample rate, alarms, and start or stop conditions for your data-logging task with your data-logging software
- Run the data-logging task
- After your hardware digitizes the sensor measurements, analyze and store your data for future use

What Can You Do With a Data Logger Besides Just Log Data?

The ability to take sensor measurements and store the data for future use is, by definition, a characteristic of a data logger. However, a data-logging application rarely requires only data acquisition and storage. Inevitably, you need the ability to analyze and present the data to determine results and make decisions based on the logged data. A complete data-logging application typically requires most, if not all, of the elements illustrated below.

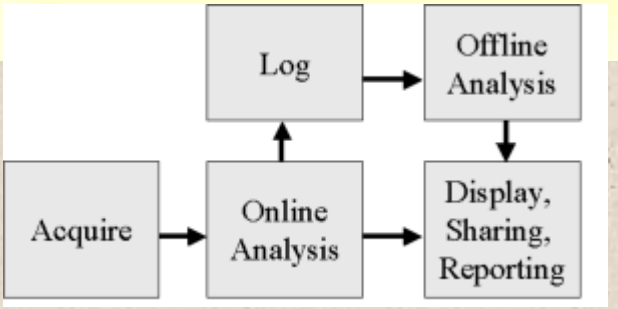


Figure 4. Data-Logging Application Elements

Acquire– This step includes your sensors and data logger hardware as well as the conversion of physical phenomena into digital signals.

Online Analysis:– This step includes any analysis you would like to do before storing the data. A common example of this is converting the voltage measurement to meaningful scientific units, such as degrees Celsius. You can complete these complex calculations and data compressions before logging the data. Controlling part of a system based on current measurements – for example, a kill switch – is also part of online analysis. Every data-logging software application should complete the conversion from binary to voltage and the conversion from voltage to scientific units.

Log:– This step refers to the storage of analyzed data including any formatting required for the data files.

Offline Analysis:– This step includes any analysis you would like to do after storing the data. A common example is looking for trends in historical data or data reduction.

Displaying, Sharing, Reporting:– This step includes the creation of any reports you need to make to present your data. However, note that the figure above shows you can also present data straight from online analysis. This represents the ability to monitor and view the data as you acquire and analyze it in addition to simply viewing historical data.

Figure 5. Data-Logger Device

GPS Data Logger:

What Does The GPS Data Logger Do:-

- Show You Up To 30 Days Of GPS Tracking
- Will Track Anyone Or Anything...
- On Land, Air, Sea - Walking, Running, Jogging...
- Shows You On A Google Map Where It Has Been
- Works Anywhere On Planet Earth

How It Works:-

- Install The Software On Your Computer
- Connect To Your Computer Via USB
- Select How You Would Like To Record Position Data
- Program To Record Position
- Based On Time, Distance And Even Speed
- Save Your Settings...
- Send The GPS Data Logger Out!

- Retrieve It...
- Connect To Your PC...
- Download Data.
- View On Google Map or Report

How View The Data Recorded By The GPS Data Logger:-

Included with every device is a USB cable and user friendly software. Simply install the software onto your windows based computer, connect the GPS Data Logger to your computer via USB cable and the program will download the waypoints (locations) records into your computer. The tracks are displayed in the software utility via Google maps. The data from the included program can be exported to Google Earth. You can also see the speed of the device at each waypoint.

III. Features:

- Built-In Motion Activated GPS Logger
- Small Form Factor: 1.5" x 1.5" x .05"
- Battery Life @ 1 Hr Driving Day = 30 Days Of Operation
- Stores Up To 120 Hrs Of Data
- Includes Magnetic Mount Case For Vehicle Tracking
- Multiple Report Formats To Export Data
  (PDF, HTML, CSV, MS-WORD, And More)
- Water Resistant For Use Outdoors
- Built-In Rechargeable 750 mAh Li-ion Battery
- Weight 1.3 Ounces
- Cold Start Satellite Acquisition Time >35 Seconds
- 64 Mb on board memory
- USB 1.1 and 2.0 Compatible

IV. Advantages of GPS loggers:

- **Adjustable tracking intervals** &emdash; You choose how often a device records its location. Generally, the more often the device records, the shorter the battery life.
- **Motion activation** &emdash; Many devices contain a motion sensor, so that they can conserve battery life by only reporting while moving.
- **Custom reports** &emdash; These can vary by device and software, but most often include Stop Reports, Speed Reports, Drive Time Reports, and Mapped Reports. Some devices can provide different types of information as well, like altitude or fuel efficiency.
- **International use** &emdash; Most loggers can be used internationally without any special programming.

V. Applications:

- Record track-logs of vehicle movement
- Use in car/4WD/truck/bus/motorcycle
- Place in sealed plastic bag for Marine use
- Prevent damage to your expensive laptop computer
- Prevent theft of your expensive laptop computer
- Record movement of Loan/Hire cars
- Record movement of delivery vans
- Record movement of aircraft
- Any other use you can imagine!
- OEM's Welcome

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