

GPS AND ITS APPLICATIONS

UNIT IV

Applications :precision farming-fishing-environment-forestry-siting and routing-surveying-navigational application

The development and implementation of precision agriculture or site-specific farming has been made possible by combining the Global Positioning System (GPS) and geographic information systems (GIS). These technologies enable the coupling of real-time data collection with accurate position information, leading to the efficient manipulation and analysis of large amounts of geospatial data. GPS-based applications in precision farming are being used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping. GPS allows farmers to work during low visibility field conditions such as rain, dust, fog, and darkness.

In the past, it was difficult for farmers to correlate production techniques and crop yields with land variability. This limited their ability to develop the most effective soil/plant treatment strategies that could have enhanced their production. Today, more precise application of pesticides, herbicides, and fertilizers, and better control of the dispersion of those chemicals are possible through precision agriculture, thus reducing expenses, producing a higher yield, and creating a more environmentally friendly farm.



Precision agriculture is now changing the way farmers and agribusinesses view the land from which they reap their profits. Precision agriculture is about collecting timely geospatial information on soil-plant-animal requirements and prescribing and applying site-specific treatments to increase agricultural production and protect the environment. Where farmers may have once treated their fields uniformly, they are now seeing benefits from micromanaging their fields. Precision agriculture is gaining in popularity largely due to the introduction of high technology tools into the agricultural community that are more accurate, cost effective, and user friendly. Many of the new innovations rely on the integration of on-board computers, data collection sensors, and GPS time and position reference systems.

Many believe that the benefits of precision agriculture can only be realized on large farms with huge capital investments and experience with information technologies. Such is not the case.

There are inexpensive and easy-to-use methods and techniques that can be developed for use by all farmers. Through the use of GPS, GIS, and remote sensing, information needed for improving land and water use can be collected. Farmers can achieve additional benefits by combining better utilization of fertilizers and other soil amendments, determining the economic threshold for treating pest and weed infestations, and protecting the natural resources for future use.



GPS equipment manufacturers have developed several tools to help farmers and agribusinesses become more productive and efficient in their precision farming activities. Today, many farmers use GPS-derived products to enhance operations in their farming businesses. Location information is collected by GPS receivers for mapping field boundaries, roads, irrigation systems, and problem areas in crops such as weeds or disease. The accuracy of GPS allows farmers to create farm maps with precise acreage for field areas, road locations and distances between points of interest. GPS allows farmers to accurately navigate to specific locations in the field, year after year, to collect soil samples or monitor crop conditions.

Crop advisors use rugged data collection devices with GPS for accurate positioning to map pest, insect, and weed infestations in the field. Pest problem areas in crops can be pinpointed and mapped for future management decisions and input recommendations. The same field data can also be used by aircraft sprayers, enabling accurate swathing of fields without use of human “flaggers” to guide them. Crop dusters equipped with GPS are able to fly accurate swaths over the field, applying chemicals only where needed, minimizing chemical drift, reducing the amount of chemicals needed, thereby benefiting the environment. GPS also allows pilots to provide farmers with accurate maps.

Farmers and agriculture service providers can expect even further improvements as GPS continues to modernize. In addition to the current civilian service provided by GPS, the United States is committed to implementing a second and a third civilian signal on GPS satellites. The first satellite with the second civilian signal was launched in 2005. The new signals will enhance both the quality and efficiency of agricultural operations in the future.

Benefits

- Precision soil sampling, data collection, and data analysis, enable localized variation of chemical applications and planting density to suit specific areas of the field.
- Accurate field navigation minimizes redundant applications and skipped areas, and enables maximum ground coverage in the shortest possible time.

- Ability to work through low visibility field conditions such as rain, dust, fog and darkness increases productivity.
- Accurately monitored yield data enables future site-specific field preparation.
- Elimination of the need for human "flaggers" increases spray efficiency and minimizes over-spray.

Odaku is a Mobile GPS bringing solutions to the fishermen community in India. Being a fishermen, we have created Mobile GPS to help the fishing industry in India. Here are various issues faced by fishermen and how we can give solutions that is embed into the GPS.

Problem

Unable to follow the Regulatory Measures – The Government has banned few areas for fishing for protecting the Marine Resources. Areas include Closed Fishing Area and Marine Protected Area (MPA). This is due to the current GPS do not provide these information.

Spatial Closure – These are areas that are defined by Government for Traditional Vessels & Mechanized Vessels. Some of the states have defined distance where Mechanized boats cannot do fishing but only smaller boats can do it. These are the regions, which always creates tension between fishermen. The main root cause is lack of knowing the border, which the current GPS does not provide.

Over Fishing– There is over exploitation of fishing near seashore and fishermen do not want to go for deep sea fishing due to Fear of unknown location and loss of money incase if they are not success in getting fish.

Lack of Data – Even though the Government provides information such as weather, tide info and PFZ, it does not reach the fishermen. The provided content is not presented for them well.

Catch Data - There is no way for them to keep record of what is being caught, where is being caught and how is being caught.

Border/Geofence issues – We have international border issue.

Limited storage on data like waypoints or tracks on the current GPS.

Loss of data when the GPS gets damaged. Hence fishermen need to have all their data to be written in notebook and use for reference.

Loss of Fuel due to searching for fish stocks or lacking of information such as waypoints, etc.

Solution

GPS is a basic tool that is needed by every fisherman who goes to sea. Odaku comes with this basic tool along with many other features for the fishermen. Odaku is a fishery platform for fishermen with complete solutions for their daily activities. Having seen the above opportunities, we have come up with solutions that can help the fishermen. We have closely worked with the fishermen on their requirement and created this product for the fishermen.

Geofence - Since India had a big coastal line and there are lots of local Geofence for fishing. These Geofence can be defined at the Cloud level and people can download these regions into this GPS. This solves lots of tensions between fishermen.

Spatial Closure & Environment Protection – The Government can define the Geofence region and fishermen can download those Data so that when they approach the area, they become aware of it and the app alerts them

Catch Report – Gives the data analytics that can be used by fishermen to target regions for fishing.

Tools that Helps in decision Making - Fishermen make decision based on the data they have. The app gives many tools to make decision while fishing. This increases the chances of catching more fish.

No need of internet or GSM Sim card - The app works offline on any Android Device with our hardware GPS Engine board. Fishermen can use their smart phone or Tablets. This becomes a cost effective for them.

Unlimited storage and Cloud backup – Taking the advantage of the Smart phone's data storage, the number of records that can be stored is huge. The data also can be used to back up in Cloud. Even if the phone or Tablet gets damaged, the fishermen can download their data from the Cloud. Hence they do not need to maintain their notebook anymore.

Share data & Save Fuel – Fishermen can share information such as Waypoints and Tracks among themselves. This helps them to save fuel. The current situation is that they use Echo Sounder to detect any obstacles under the sea before putting the Fishing Net into the sea. People can save these tracks and share it so they can fish without any fear

Push Notification to deliver messages timely – Send messages to the fishermen whenever new Fishing zones are available.

Our Vision

In order to help the fishermen community, The following are the three stakeholders under this platform for a successful business model.

Government– Government can provide the information such as PFZ, Tide, weather report for the fishermen using the satellite communication.

Fishermen– Fishermen can use the content provided by the Government and increase their Fish Catch giving more income and less fuel consumption.

Private Companies / Agencies – Private companies or Fishermen Agencies can sell their products directly to fishermen. Fishermen can also sell their stock directly to end customers or wholesale dealers using the platform which cuts down the middlemen and thus increasing the Quality of the fish on the supply chain.

To sustain the Earth's environment while balancing human needs requires better decision making with more up-to-date information. Gathering accurate and timely information has been one of the greatest challenges facing both government and private organizations that must make these decisions. The Global Positioning System (GPS) helps to address that need.

Data collection systems provide decision makers with descriptive information and accurate positional data about items that are spread across many kilometers of terrain. By connecting position information with other types of data, it is possible to analyze many environmental problems from a new perspective. Position data collected through GPS can be imported into geographic information system (GIS) software, allowing spatial aspects to be analyzed with other information to create a far more complete understanding of a particular situation than might be possible through conventional means.



Before and after imagery of Amazon deforestation

Aerial studies of some of the world's most impenetrable wilderness are conducted with the aid of GPS technology to evaluate an area's wildlife, terrain, and human infrastructure. By tagging imagery with GPS coordinates it is possible to evaluate conservation efforts and assist in strategy planning.

Some nations collect and use mapping information to manage their regulatory programs such as the control of royalties from mining operations, delineation of borders, and the management of logging in their forests.

GPS technology supports efforts to understand and forecast changes in the environment. By integrating GPS measurements into operational methods used by meteorologists, the atmosphere's water content can be determined, improving the accuracy of weather forecasts. In

addition, the proliferation of GPS tidal tracking sites, and improvement in estimating the vertical component of a site's position from GPS measurements, present a unique opportunity to directly observe the effects of ocean tides.



Gulf of Mexico.

In 2010, GPS helped cleanup crews respond to the massive oil leak in the

GPS receivers mounted on buoys track the movement and spread of oil spills. Helicopters use GPS to map the perimeter of forest fires and allow efficient use of fire fighting resources.

The migratory patterns of endangered species, such as the mountain gorillas of Rwanda, are tracked and mapped using GPS, helping to preserve and enhance declining populations.

In earthquake prone areas such as the Pacific Rim, GPS is playing an increasingly prominent role in helping scientists to anticipate earthquakes. Using the precise position information provided by GPS, scientists can study how strain builds up slowly over time in an attempt to characterize, and in the future perhaps anticipate, earthquakes.



Endangered monk seal with GPS-enabled tracking device

Another benefit to using GPS is timeliness with which critical products can be generated. Because GPS data are in a digital form available at all times and in all parts of the world, they can be captured and analyzed very quickly. This means that it is possible for analysis to be completed in hours or days rather than weeks or months, thus ensuring that the final product is timelier. With the rapid pace of change in the world today, these savings in time can be critical.

The modernization of GPS will further enhance the support of GPS technology to the study and management of the world's environment. The United States is committed to implementing two additional civilian signals that will provide ecological and conservation applications with increased accuracy, availability, and reliability. Tropical rain forest ecology, for example, will

benefit from the increased availability of GPS within heavy foliage areas and the reduction of spatial error in fine-scale vegetation mapping.

Note: The main text of this page has not been updated since 2006.

Benefits

- GPS data collection systems complemented with GIS packages provide a means for comprehensive analysis of environmental concerns.
- Environmental patterns and trends can be efficiently recognized with GPS/GIS data collection systems, and thematic maps can be easily created.
- GPS data can be quickly analyzed without the preliminary requirement for field data transcription into a digitized form.
- Accurate tracking of environmental disasters such as fires and oil spills can be conducted more efficiently.
- Precise positional data from GPS can assist scientists in crustal and seismic monitoring.
- Monitoring and preservation of endangered species can be facilitated through GPS tracking and mapping.

“Until the advent of GPS tracking, it was practically impossible to record elephant movements with sufficient temporal resolution to give a full picture of movement patterns. The presence of elephants in Kenya is a key indicator of the health of the environment.”

The global positioning system or the GPS is made up of satellites that are constantly orbiting the earth transmitting signals that are received by anyone in the world with a GPS receiver. GPS has a variety of applications in different areas different from forestry. In forestry however it can be used in; fire prevention, aerial spraying, fire control, harvesting operations, determination of boundaries, mapping systems, wildlife management as well as insect infestations.

1. Aerial spray application

GPS has qualities such as accuracy, identification of the correct positions, and boundaries that have enabled it through the years to be used to apply herbicides fertilizers and insecticides efficiently. The use of GPS enables good boundary marking hence ensuring there are none targeted areas that are not interfered with.

2. Mapping systems

GPS mapping systems are applied in the forest to help users with access to a phone or a laptop to get locations through a moving map display. This system is the same one encrypted on smartphones for easy location identification.

3. Fire Control

Wildfires have been reported from time to time with their known destruction to the environment and property. Thanks to GPS this disaster is controlled in such a way that, it creates maps that help the personnel on the ground to assess the damages done. GPS is used to locate the possible hot spots within a few minutes which is then transmitted to the personnel on the ground.

4. Harvesting Operations

GPS, in this case, is used to track the movements of the forest machine movements. The process of tracking these machines has enabled the forestry officials to understand how the forest machines are used together with their transportation network. Besides the GPS is helpful due to its accuracy and most of its information helps to create maps.

5. Single Tree Selection

GPS has been successfully been applied in the single tree selection system in Japan due to its ability to locate the exact geographic location of the marked trees. GPS generated maps and GPS handheld receiver have all been used to aid the tree marking and selection.

6. Location of sample plots in forest stands

The ability of a GPS to find the exact geographical positions is used in this case. The GPS helps the forest personnel to navigate through dense forest canopies.

7. Navigation for aerial surveys

GPS can be fixed in a helicopter which can help identify boundaries of a forest fire. The GPS can also be used in identifying the trees most likely to get damaged by the fires. Besides the GPS is used by researchers and forest personnel to collect data and navigation.

8. Wildlife Management

GPS is well known for its accuracy and ability to show the exact position of any target. In this case, GPS is used to trace the movements of wildlife and their activities over time.

9. Insect Infestations

Through the GPS waypoint navigation, the forestry personnel easily determine the insect infected areas that are they get the exact positions as well as their positional boundaries.

10. Determination of boundaries

Boundaries may be in terms of forest fires boundaries, insect infestations boundaries, wildlife boundaries, and more. GPS either on laptops, in helicopters, or phones easily locates the boundaries of the above mentioned.

In conclusion, GPS technology has proved efficient in helping out the forest personnel most especially in managing possible disasters and locational and navigational work easier.

- Location — Determining a position.
- Navigation — Getting from one location to another.
- Tracking — Monitoring object or personal movement.
- Mapping — Creating maps of the world.
- Timing — Making it possible to take precise time measurements.

The surveying and mapping community was one of the first to take advantage of GPS because it dramatically increased productivity and resulted in more accurate and reliable data. Today, GPS is a vital part of surveying and mapping activities around the world.

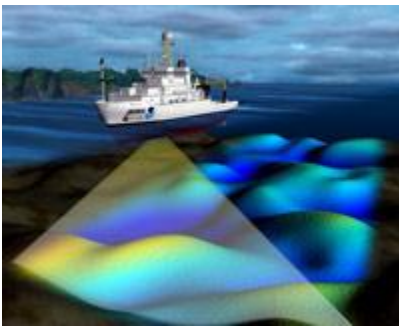
When used by skilled professionals, GPS provides surveying and mapping data of the highest accuracy. GPS-based data collection is much faster than conventional surveying and mapping techniques, reducing the amount of equipment and labor required. A single surveyor can now accomplish in one day what once took an entire team weeks to do.



GPS supports the accurate mapping and modeling of the physical world — from mountains and rivers to streets and buildings to utility lines and other resources. Features measured with GPS can be displayed on maps and in geographic information systems (GIS) that store, manipulate, and display geographically referenced data.

Governments, scientific organizations, and commercial operations throughout the world use GPS and GIS technology to facilitate timely decisions and wise use of resources. Any organization or agency that requires accurate location information about its assets can benefit from the efficiency and productivity provided by GPS positioning.

Unlike conventional techniques, GPS surveying is not bound by constraints such as line-of-sight visibility between survey stations. The stations can be deployed at greater distances from each other and can operate anywhere with a good view of the sky, rather than being confined to remote hilltops as previously required.



GPS is especially useful in surveying coasts and waterways, where there are few land-based reference points. Survey vessels combine GPS positions with sonar depth soundings to make the nautical charts that alert mariners to changing water depths and underwater hazards. Bridge builders and offshore oil rigs also depend on GPS for accurate hydrographic surveys.

Land surveyors and mappers can carry GPS systems in backpacks or mount them on vehicles to allow rapid, accurate data collection. Some of these systems communicate wirelessly with reference receivers to deliver continuous, real-time, centimeter-level accuracy and unprecedented productivity gains.



To achieve the highest level of accuracy, most survey-grade receivers use two GPS radio frequencies: L1 and L2. Currently, there is no fully functional civilian signal at L2, so these receivers leverage a military L2 signal using "codeless" techniques.

The ongoing GPS modernization program is adding a dedicated civil signal at L2 that supports high-accuracy positioning without the use of military signals. The GPS program is also adding a third civil signal at the L5 frequency that will enhance performance even further. After 2020, the government will no longer support codeless access to military GPS signals.

Benefits

- Significant productivity gains in terms of time, equipment, and labor required
- Fewer operational limitations compared to conventional techniques.
- Accurate positioning of physical features that can be used in maps and models.
- Faster delivery of geographic information needed by decision makers.
- Centimeter-level surveying results in real-time.

“The most effective way to achieve a robust and globally consistent continental reference system is through the technology of the Global Positioning System (GPS). The explosive growth of GPS applications and the economics of GPS make it the technique of choice for sustainable geodetic operations within Africa.”

GPS is used in agriculture and fisheries for land area mapping, yield monitoring, precision planting of crops, spraying and harvesting, autonomous vehicle control and to monitor fishing limits.

GPS technology is now in everything from cell phones and wristwatches to bulldozers, shipping containers, and ATM's. **GPS** boosts productivity across a wide swath of the economy, to include farming, construction, mining, surveying, package delivery, and logistical supply chain management.

