Modern Surveying Techniques

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Lecture - 5

GPS Application

In the previous session I had discussed regarding the various solutions that a GPS can provide. Subsequently, the errors which could accrue were also discussed and how they can be removed was also discussed in detail. In this session, I am now going to focus my attention on the various applications to which GPS can be used to. First application that we would like to focus upon is surveying and mapping.

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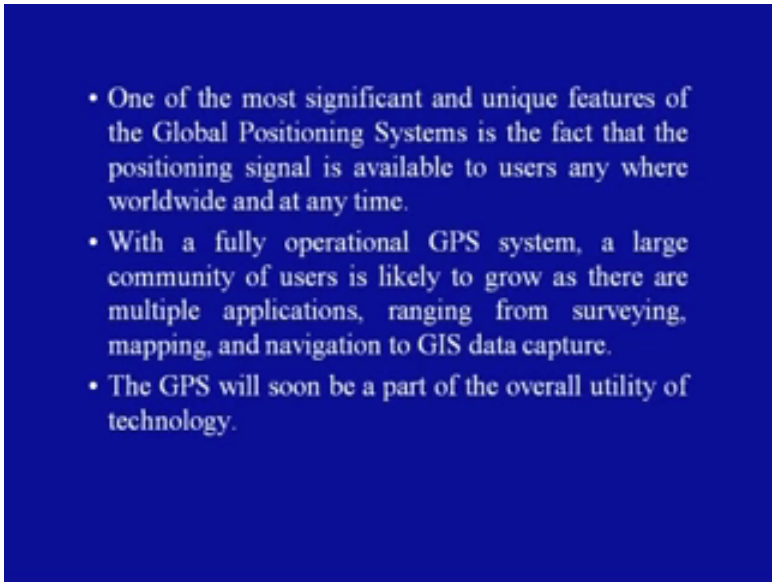

One of the most significant features of global positioning system is the fact that the positioning signal is available to the user anywhere worldwide. With a fully operational GPS system, a large community of users is likely to grow as there are multiple applications ranging from surveying, mapping and navigation to GIS data capture.

The GPS will soon become a part of the overall utility of the technology. Now, let us look at one by one the different applications that can be used by the user for using a GPS.

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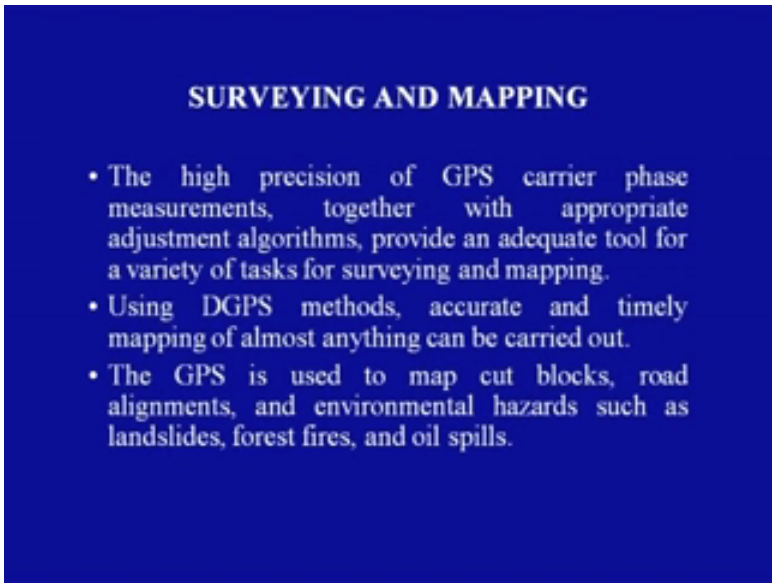

The first and foremost application of GPS is in the area of surveying and mapping. The high precision of GPS carrier phase measurements together with appropriate adjustment algorithms provide an adequate tool for various task of surveying and mapping.

Using DGPS methods, accurate and timely mapping of all most any thing can be carried out.
The GPS can be used to map cut blocks, road alignments and environment hazards such as landslides, forest fires and oil spills.

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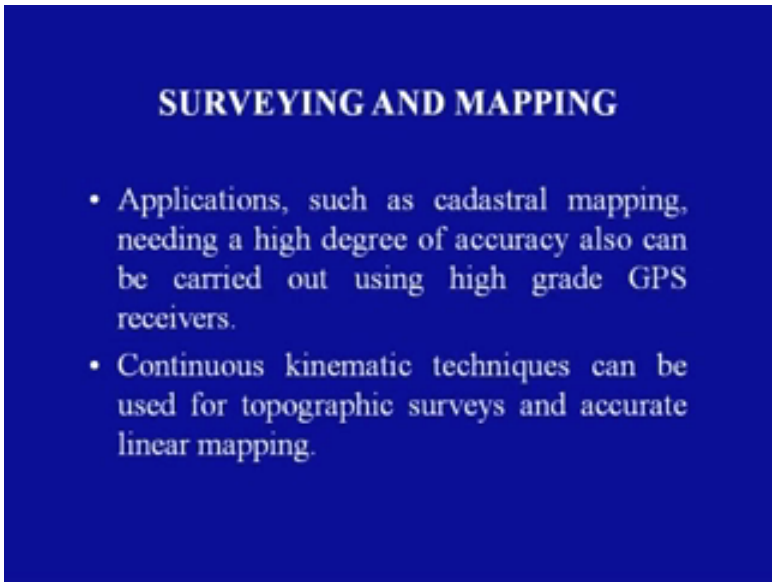

Applications such as cadastral mapping, needing a high degree of accuracy also can be carried out using GPS receivers. Continuous kinematic techniques can be used for topographic surveying and mapping of linear features.

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In this particular slide, one can see the manner in which the observations can be taken with a GPS for mapping purposes. The use of GPS can also be integrated with a total station; another equipment which is a high level technology equipment for undertaking surveying and mapping.
By integration of both these two technologies, it is possible to undertake very high and accurate level of mapping along with economical procedures as it reduces lot of time and thus the cost get reduced.

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Another area of GPS is in the area of engineering, specifically when objects which are big and require continuous monitoring in terms of various parameters such as deflection or to measure the status of the health of a particular building, GPS can provide very effective continuous precise information regarding the structure.
In this, this particular slide, you can see a GPS antenna has been placed on a building top which is continuously observing the position of the building top in order to see what sort of vibrations are being generated by the traffic which is moving close by on the building. Based on this, one can work out what are the vibrations to which the building is being subjected to.

Similarly, one can also attach the GPS equipment to a dredger wherein, the precise elevations of the ground points can be fed and using the GPS based information, the ground can be leveled as per the requirement. This reduces lot of manual errors which may otherwise, may creep in by using without using a GPS.

A very unique example of monitoring heavy structures such as dams is the forte of GPS observations. Here, on the one of the pictures you can see, the a concrete dam which on which the GPS equipments have been placed and these are providing information regarding the stresses that are being developed within the dam body due to hydrodynamic forces. During adverse conditions, the GPS will record the the precise positions on the dam face regarding the deflection that may be subjected to due to certain forces which could be hydrodynamic or could be wind induced forces on the structure.

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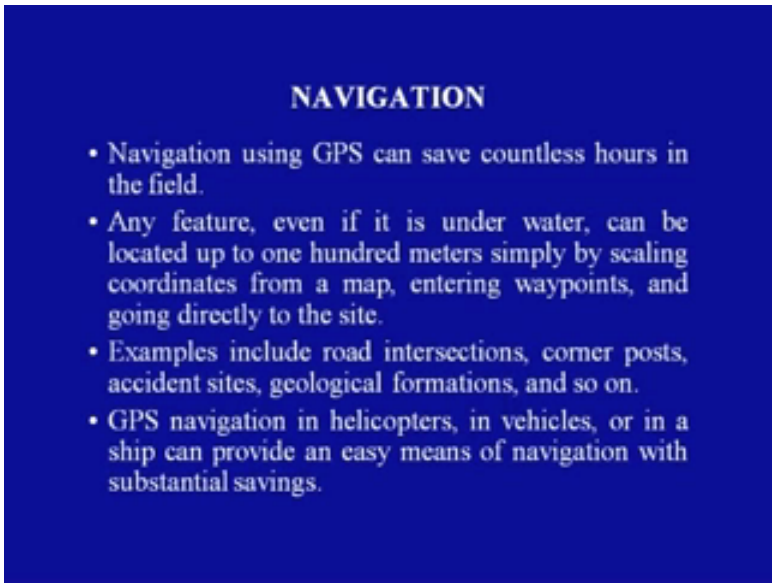

Another common area to which GPS has provided very useful application and that is navigation. Well, it can save many hours in the field. Any feature, even if it is under water, can be located up to 100 meters simply by scaling coordinates from a map and entering the waypoints and going directly to the site.

Other examples could be finding out road intersections, corner post, accident sites, zoological formations and so on. GPS navigation in helicopters, in vehicles or in a ship can provide easy means of navigation with substantial saving.

So, now let us look at what are the various applications to which GPS in terms of navigation can provide.

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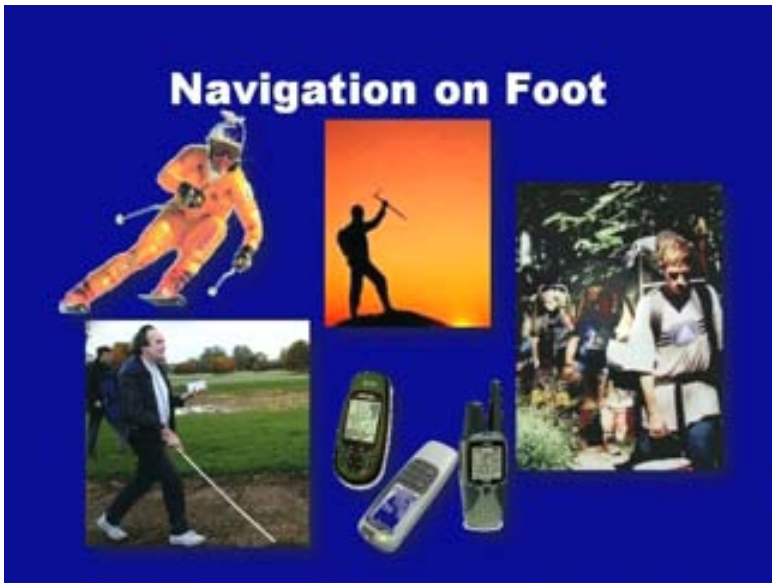

First of all, navigation on foot; here, a person can have a low end GPS which he may carry it in his hand. We can see, one person is carrying a GPS in his hand and is moving along the path which is desired. Or a skier, as he moves along; the ski slopes, he can his movement can be monitored by GPS where these GPS's may not be very accurate GPS's and by and large, these are handheld GPS's.

In fact, in the present day context, a GPS has been successfully embedded on to a cap of a person. So, with this type of equipment, it provides a continuous monitoring to the person who is moving in an unknown area or if there is a monitoring of a person as he is moving through uncharted areas, he can be tracked effectively.

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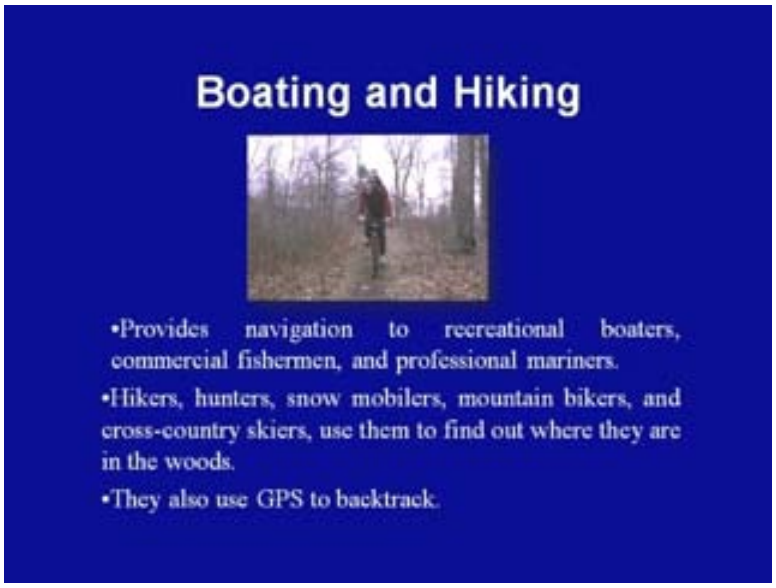

Another area is boating and hiking. Well, it provides navigation to recreational boaters, commercial fisherman and professional mariners. We must remember that in this type of application also the accuracy is not a big question. Here, low end GPS's which are cheap can be procured and individually used by people when they are involved in such type of activity. It has been found that hikers, hunters, snowmobilers, mountain bikers and cross country skiers use them to find out where they are in the woods. They can also use the GPS for backtracking that is to chart their return path from there to their origin point.

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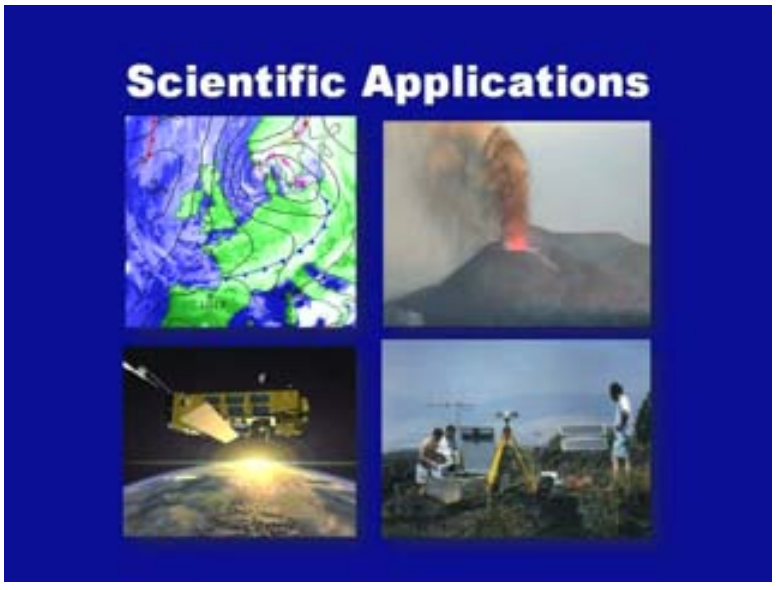

Let us come to some of the scientific applications to which GPS can be used. One very important area is in the field of weather monitoring. A GPS can transmit very good information regarding the weather conditions which are there because it has the capability to identify the different types of errors which are there which can be subsequently translated into possible informations in terms of what is the water vapour in the air and subsequently it can be used for weather monitoring thereafter.

It can also be used in hazard based activities such as volcano eruption or if one is interested in monitoring crustal plate movements or what we call it as tectonic plate movements, there precise GPS's can be used to identify what is the motion that the earths crustal plates are being subjected to during certain hazardous activities such as collision of the tectonic plates or during a earthquake which may occur at a particular location on the earth surface.

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Another area of application is in the field of automobile engineering. Automobile industry, as a matter of fact is now providing GPS fitted cars. For example; General Motor or BMW, they are providing the GPS based cars so that a person can use this to find out what could be the possible route or transmit the same information in terms of a movement which may be taking place in an uncharted area.

GPS guides and locates boats and automobiles. It can be found in cars or boats as handheld devices similar to cellular phones. Well, by adopting these types of systems in vehicles, it provides greater or increased driving efficiency; the driver may not have to pay too much of attention to the road because the route is marked out. In cars, they may help assist, their drivers in maneuvering around the city or when they are lost in a particular country.

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This particular slide, it shows how a GPS can be placed on the roof a car and a small unit is placed, it can either be handheld or it can be fixed to any point convenient to the driver for monitoring or it could be connected to a laptop.

The person may have the city map and based on the location of the car, a point would appear on the laptop which would signify his present location and as he is in motion, this particular dot continuously moves over the map and the person is able to identify on which road he is moving and which could be the possible next deviation to the map of the route that he may have to undertake, in case if there are any road blocks.

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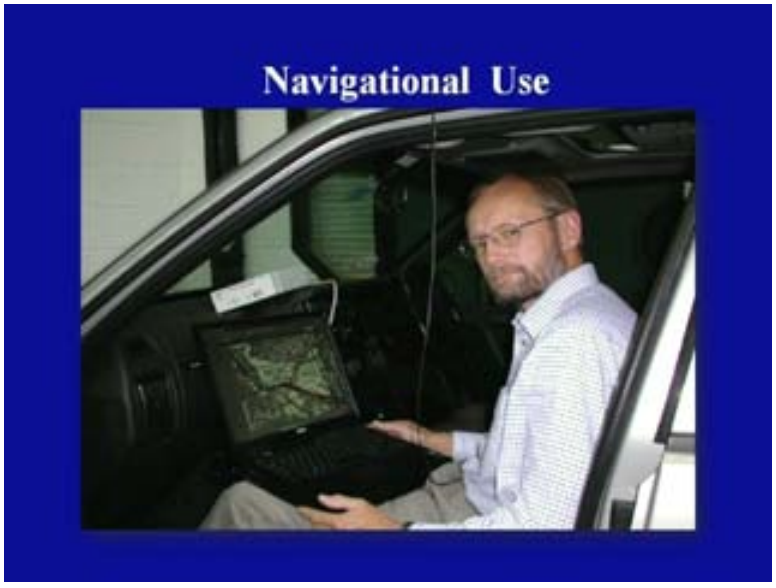

Presently, some the manufacturers are providing a small panel on the dash board itself wherein, one can see a 3 dimensional view of the area through which he is navigating.

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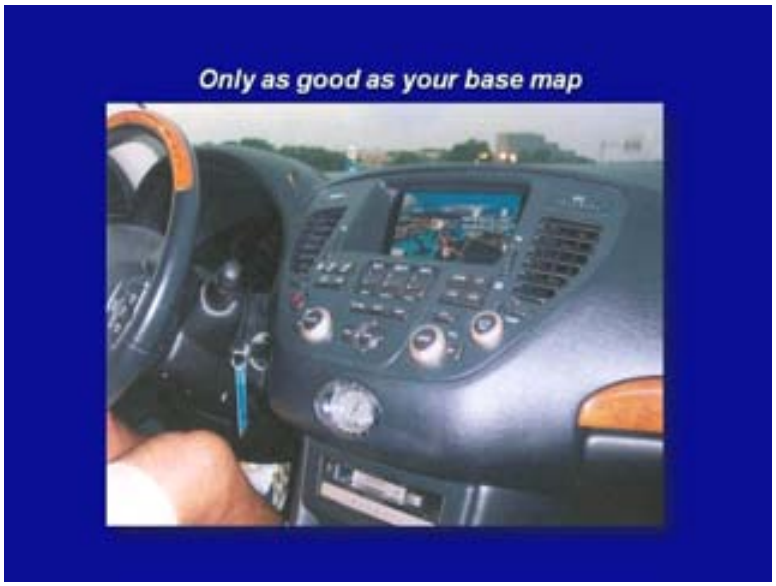

And thus, he can get a very clear idea as to what could be the physical obstructions which are present and he can maneuver around them.

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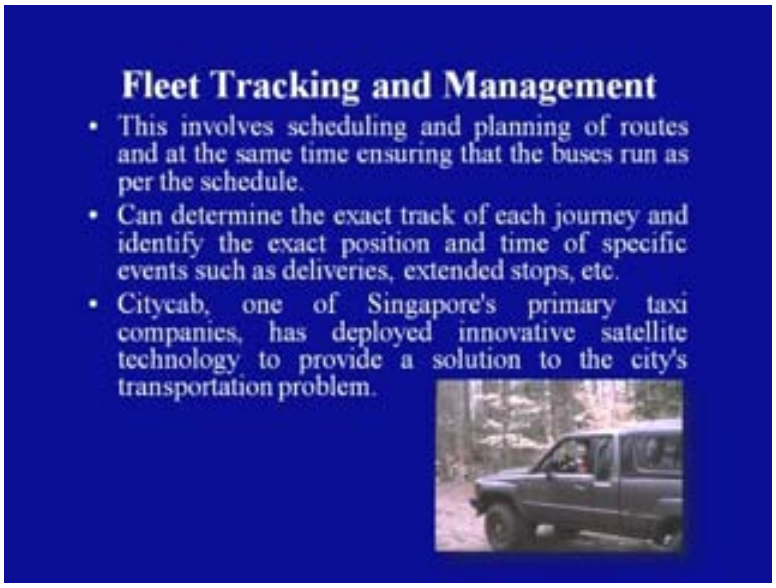

Another area that has found GPS applications is fleet tracking and management. This involves scheduling and planning of routes and at the same time ensuring that the buses run as per

schedule. This can determine the exact track of each journey and can identify the exact position and the times of specific events such as deliveries, extended stops etc.

Citycab, one of the Singapore's primary taxi companies has deployed innovative satellite technology to provide a solution to the city's transportation problem. Presently, in our country also in very new concept of radio taxies have been introduced.

Well, these radio taxies are continuously transmitting their position to their master control which may be located at some point and on the panel; every car, its position is identified. Depending upon a request made by a user to hire a taxi, the person on the control panel can identify which taxi is closest to the point of request and thus a car can be immediately informed regarding the service which has now been placed to that particular company.

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In aero planes, this is a very common feature presently because it provides exact position to any user or to the air traffic controller as to where the aircraft is presently located. So, in case of any mishap, it can immediately the ATC can immediately identify that something has gone wrong and a rescue machine can be undertaken to salvage or save the passengers.

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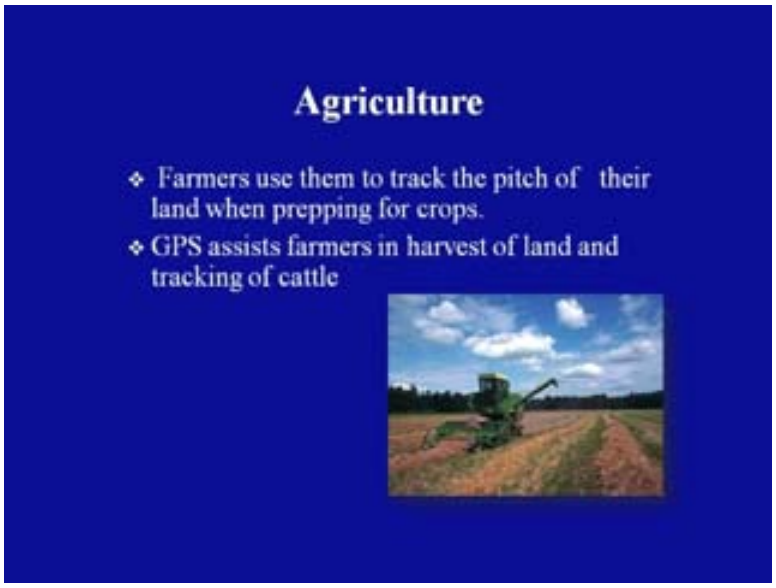

Another important area which is now coming up is in the field of agricultural. Farmers are using them to track the pitch of their land when preparing for their crops. Also, GPS assists the farmer in harvesting of the land and also tracking of the cattle.

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A very recent phenomenon which has been added to be application of GPS is the mobile phone industry. The world's two largest digital cellular phone companies; Nokia of Finland and Ericsson of Sweden and a Japanese microelectronics giant plant have announced to produce GPS chips to be installed in cellular phones.

Well, this will help in identifying the location of each such type of cellular phone to any agency or security agency in case of any threat or in case of any terrorist activity.

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An important area of GPS is in the field of military applications. One of the very primary task to which GPS has found its use is in helping to track the movement of soldiers and missiles. Many times the soldiers have to go into uncharted areas and they have no idea regarding what lies before them; specifically, when they are crossing glaciers.

So in these areas it is important that if the soldiers have small GPS's located within their body, then they can be continuously tracked and in case of a mishap, they can also be retrieved so that life saving activities can be undertaken.

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Another area wherein, GPS has now found a large number of applications and that is in cases of emergency. That is it has now become a tool for the police to track people as they are moving, in order to identify the type of problem which may be there located at a particular position.

It can also be used in cases of fire hazard to identify which are the zones which are effected by fire, specifically in case of forest fire where many times it is very difficult to penetrate into the disaster zones. Similarly, GPS's can help in rescue activities so that helicopters can be pressed into service and they can reach to precise locations, provided, the user has a GPS along with him. And thus, it can help and reduce substantial time in providing relief to a person who maybe in distress.

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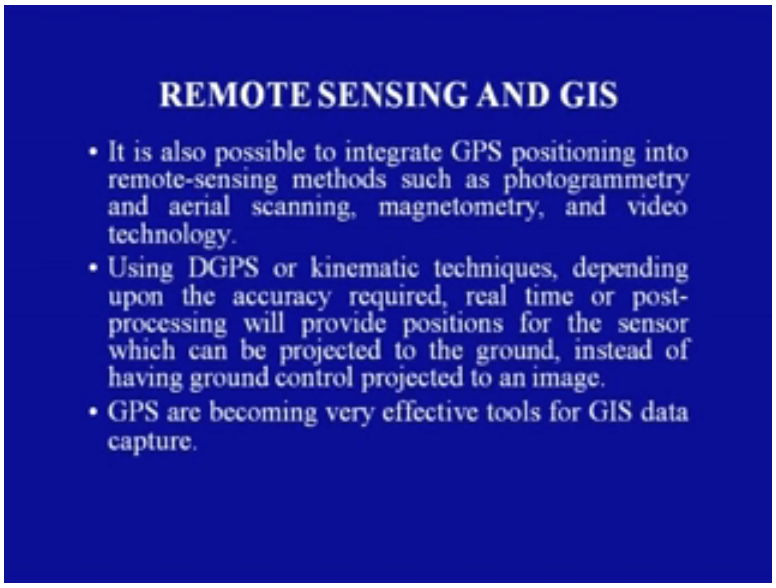

Another area where a GPS's is has provided lot of application and that is remote sensing and GIS. It is possible to integrate GPS positioning into remote sensing methods such as photogrammetry and aerial scanning, magnetometry and video technology.

Using DGPS or kinematic techniques, depending upon the accuracy required, real time or post processing will provide positions for the sensor which can be projected to the ground instead of having the ground control projected on to the image.

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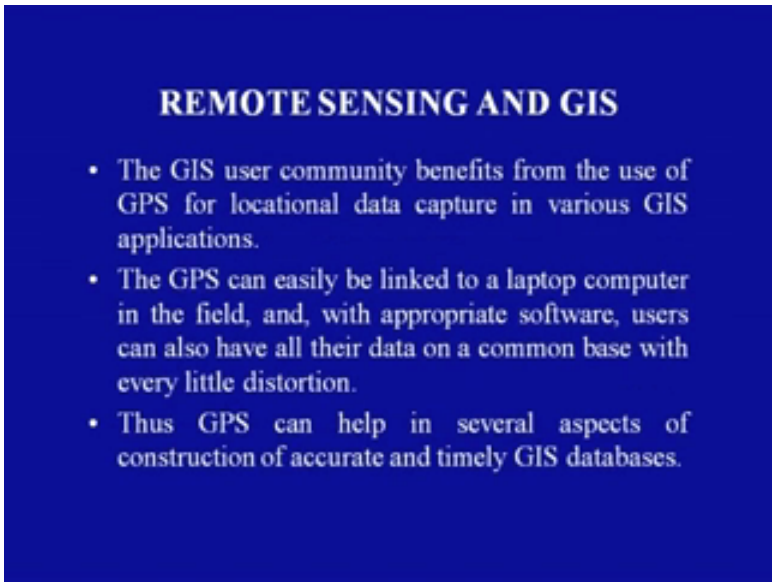

GPS's are becoming very effective tools for GIS data capture also. The GIS user community benefits from the use of GPS for locational data capture in various GIS applications. The GPS can easily be linked to a laptop computer in the field and with appropriate software, users can have all the data on a common base with every little distortion taken care of.
Thus, GPS can help in several aspects of construction of accurate and timely GIS databases.

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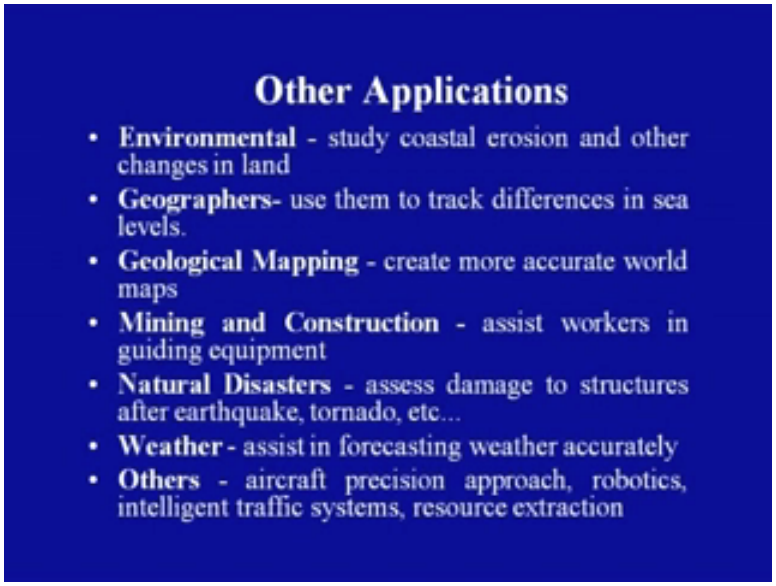

Apart from this there are many other areas in which GPS can be used. These are; first, environmental engineering wherein, one may like to study coastal erosion or other changes in the land which may be taking place, geographers can use to track differences in sea levels, geologist can use it for geological mapping so that they can create more accurate world level maps, in the mining and construction engineers, it can assist in guiding equipment to specific locations, in the area of natural disasters, it can be used to assess damage to structures after earthquake, tornados etc.

It can assess in forecasting weather accurately and also provide very precise approach to aircraft landing or taking off, in the area of robotics, intelligent traffic systems and resource extraction
Well, this is just a list but this list is long. However, with this the reader should be now able to appreciate the utility of GPS in this particular context of the modern day world wherein, data is very critical and needs to be acquired very quickly.

With this, I end the use of GPS in different areas.

Thank you.