BIOGRAPHICAL INFORMATION
Ashok Wadwani
President
Applied Field Data Systems Inc.

Specific Responsibilities

Ashok Wadhwani is the Founder and President of Applied Field Data Systems Inc., based in Houston, Texas. Applied Field Data Systems offers over 40 years of experience in providing total solutions in Field Data Collection Systems, specializing in GPS, GIS and mapping applications. In addition they offer consulting, software development, data conversion, training, and AVL services and systems integration. They serve various markets and industries, such as, Oil and Gas, Pipelines, Environmental, Natural Resources, Utilities, Municipalities.

Past Experience

Prior to launching Applied Field Data Systems, Ashok Wadwani was President of A.I.W. Inc for 11 years. He designed industry's first ruggedized, and intrinsic safe datalogger for the fugitive emissions monitoring applications in refineries and chemical plants. This datalogger is being presently used by all Fortune 500 Companies. He has written several articles, presented papers and conducted numerous workshops in the area of Field Data Collection in the United States and overseas.

Educational Information

M.S. - Physics, University of Lucknow, India
MBA -Northwestern University, Evanston, Illinois.

Professional Memberships

Geospatial Information Technology Association (GITA)
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RECENT ADVANCES IN MOBILE DATA COLLECTION

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ABSTRACT

The presentation will cover tremendous advances in mapping technology which have taken place during the last few years. These advances have made the tasks of mobile mapping very easy and economical. The presentation will cover advancements in the area of GPS receivers, DGPS services, field data collection software, laser range finders and GPS based digital cameras. A mobile GPS/GIS data collection project can now be easily handled by utilizing these new generation products which are light weight, economical and easy to use.

INTRODUCTION

Due to increasing regulatory and security issues, mapping of assets is taking an important role in the pipeline and other related industries. Until recently, the tools available for mapping applications had been bulky in size and weight, expensive, and difficult to learn. During the past few years, tremendous advances have taken place in GPS technology (receivers), DGPS correction services, and field data collection software. Not only has the autonomous GPS accuracy improved, but the data collectors have become smaller, lighter, and less expensive. Integrated GPS receivers built in PDA'S have been introduced also. The software has become cheaper and easier to learn. Digital cameras with GPS are now being introduced making it easier for operators to capture locations, record features and attributes with a picture. In addition, for applications involving offsets, lower priced laser range finders have become available All of these advances have made the GPS/GIS data collection tasks easier, more economical and faster to complete.

ADVANCEMENTS

GPS RECEIVERS

The GPS receivers available now are much smaller, lighter, cheaper, and above all, offer a longer battery life. Due to the improvements in technology and elimination of Selective Availability, GPS receivers provide better accuracy.. Today a hand held receiver, with a price tag of around $100 can provide accuracy of around 10-15 meters without any corrections. Some of them can even display a background map. Most GPS receivers also have much easier to use on board software. With the introduction of Blue Tooth technology, BT enabled GPS receivers have been introduced. PDA and Tablet PC'S with integrated GPS receivers are also quite readily available. (See Fig 1)

Fig 1

DGPS SERVICE.

It is also now possible to obtain accuracies of 1-5 meters, sub meter, decimeter as well as centimeter levels with the use of DGPS at either no cost or very reasonable cost. These DGPS corrections are available through Coast Guard Beacons, WAAS, or private and public sources.

The Coast Guard service which was initially available only in the Coastal areas of the country is now being expanded to non coastal areas also. The WAAS service is expected to be fully operational within the next year or so and is expected to provide 1-5 meter accuracy throughout the USA.

There has also been an introduction of Decimeter DGPS service by private companies. This provides +/- 10 cm accuracy by using a special receiver and the service is available throughout the USA.

In addition, Federal, State, Municipal and private entities are now installing their own reference DGPS stations providing real time DGPS corrections via the Internet and cell phones/radios etc. To use this service, one needs to buy the appropriate GPS receiver with a data collector equipped with modem card. Most of the State and Federal agencies offer these services free. Private Companies who have invested their own funds to set up the reference station are charging monthly/annual fees. The cost depends on the amount of data used. This service is providing centimeter level accuracies in real time.

DATA COLLECTORS

The earlier generation data loggers for GPS, and even some of them available at present, use either on board memory or an external data logger. In most cases, software on these units is extremely complicated and difficult to learn. The data collectors are vendor specific to GPS engines only and cannot be used for any other applications. The units come with a proprietary operating system which makes modifications difficult to incorporate. These units have slower processors thus making the manipulation and processing of data and maps impossible or very slow. The older generation data collectors have low battery life and are expensive to replace.

With the introduction of Palm Pilots followed by Microsoft's launch of a Windows Pocket PC/ C/E operating system, a new generation of handheld Personal Digital Assistants (PDA's) have flooded the market. It is now possible to use these lightweight handheld PDA’s, with GPS/GIS data collection software, for field applications. In addition, regular windows based tablet PC's are now available in ruggedized waterproof versions. One can use these PC’s for mapping applications in tough, outdoor environments encountered in the pipeline and related industries. Several manufacturers such as HP, TDS, ITRON, Walkabout Computers offer new generation of these data collectors. (See fig 2.)

Fig. 2

The new data collectors are economically priced ranging from $300 - $4000. Widespread familiarity with the Palm, Pocket PC, and Windows operating systems has resulted in a quick and easy GPS/GIS integration with these devices. As these units can be used with or without GPS, other field data collection applications can be handled.

They have longer battery life, 14-16 hours. They are also light weight, thus making it easy for the user to carry the units all day in the field. In addition, most data collectors have touch screens and come with a color display that has good resolution when used outdoors in the sunlight. Most of them have voice activation option and this comes in

useful to save verbal notes while collecting data. The units come with the USB ports and built in modems as well as expanded memory with CF card option. Some of them are also Blue Tooth Enabled.

FIELD DATA COLLECTION SOFTWARE

The data collection software which was available many years ago was very complicated and difficult to learn. It was also very vendor specific to the vendor's GPS engine. The software could be used only on a Windows platform and was very expensive.

Some of the new software introduced during the past year or so are: Fieldworker, Solofield, ArcPad, Sitemate, etc. This new generation of software is capable of operating, on both, the Windows and Pocket PC operating systems. Since the screen displays are same, one can use the bigger display of the PC for training and data dictionary creation purposes. This allows for quicker familiarization of the software and shorter learning curve.

The software is very economically priced, between $50-$2000 and has the capability to add background maps or digital orthophotos. Most of the new generation software allows the user flexibility to use any type of GPS engine from a low priced recreational type unit to a high accuracy survey grade unit. The software has the capability of reading from 2 serial ports allowing the user to use a GPS receiver as well as an additional sensor, such as, a laser range finder or depth or corrosion probes. The software can also accept digital camera input allowing user to capture not only the location data but also the actual picture of the feature. Once the location, features and attribute data have been collected, all of the data can be exported in different GIS formats, such as ArcView shape or AutoCad DXF files.

Recently a software has also been introduced which allows for post processing of GPS data from low cost hand held GPS receivers and achieve sub meter accuracy.

LASER RANGE FINDERS

While GPS technology has made rapid advances, there are still inherent problems with data collection when utilizing GPS.
They are:

1)There is the need for occupation of the point where GPS readings are required and sometimes its just not possible to reach the point of interest.

2)The point may be reachable, however, due to other factors, such as disturbance of wild life, areas of high traffic volume, or private property, etc, one may not want to get there.

3)In some cases, the receivers cannot receive GPS signals, such as, in heavy tree canopy and near high rise buildings.

4)GPS mapping is slow if you have to map several assets as you have to occupy each individual feature.

To overcome some of the limitations of the GPS technology, laser range finders have now become available at a reasonable price and offer reasonable performance. These units can be used with or without GPS. The key to laser mapping is: you do not have to get there from here and occupy the feature! Instead, just shoot it with the laser. (See Fig. 3)

Fig. 3

The eye-safe diode pulse laser measures distance without reflectors and has a tilt sensor built in to provide vertical angles. In addition, it has an option for a digital flux gate compass or angle encoder (not affected by magnetic fields) to provide an azimuth reading. The mapping grade range finders provide an accuracy of about 5 cm to 1.5 meters. Maximum range varies from about 500 to 5000 ft. The Range Finder can be used in different ways depending on the application, for example, direct GPS integration, indirect GPS integration, or Independent Laser Mapping.

In direct GPS integration, you place the range finder at the same spot where you place your GPS unit – in fact on the same range pole if possible. The laser unit sends the distance and azimuth readings to the GPS data collector and the software converts the laser readings to LAT/LONG based on the GPS antenna position as the reference. (See Fig. 4)

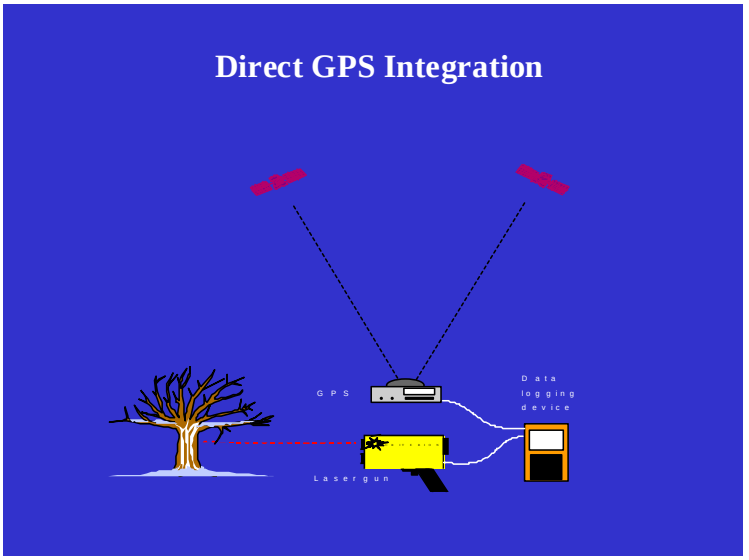

Fig. 4

In cases where GPS signals are blocked or not available, GPS antenna is placed in a clear area where signals are available. The range finder can be placed from where maximum numbers of features are visible. The laser unit transmits the distance and azimuth readings to the data collector and the software converts to LAT/LONG based on the GPS antenna position. (see Fig 5)

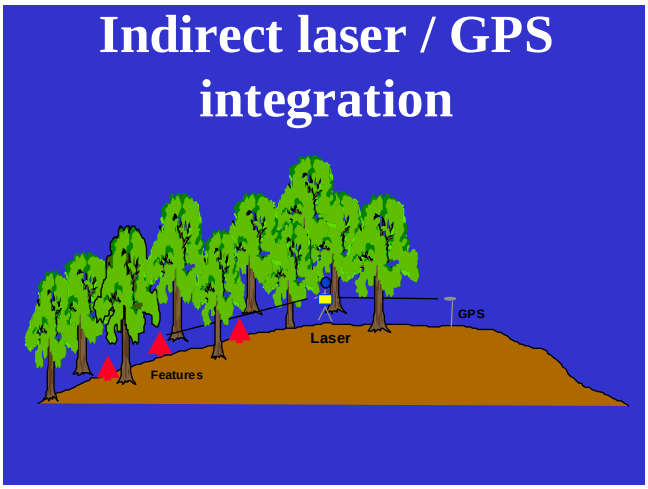

Fig.5

Laser Range finders can also be used without GPS. Here you place the laser at any reference point (base map coordinates, survey points etc) and call it “ORIGIN”. From this origin, you can shoot the laser to various points of interest and the distance and azimuth readings are sent to the data collector and stored. In this method the position of features are accurate to base maps and to each other. The data collected by this method will be relative to each other only and not absolute. However any time GPS coordinates for any point become available, they can be entered in the software and all the relative data gets converted to absolute data in LAT/LONG.

DIGITAL CAMERA AND GPS

There are 2 different options available when collecting GPS data with photographs. In the first option, you use the software and download the GPS data and the photographs from a digital camera. The software merges, both, the GPS data and digital pictures and provides a photograph with LAT/LONG, date and time printed on the photograph which can be then opened in GIS software or be exported as HTML (see Fig 6)

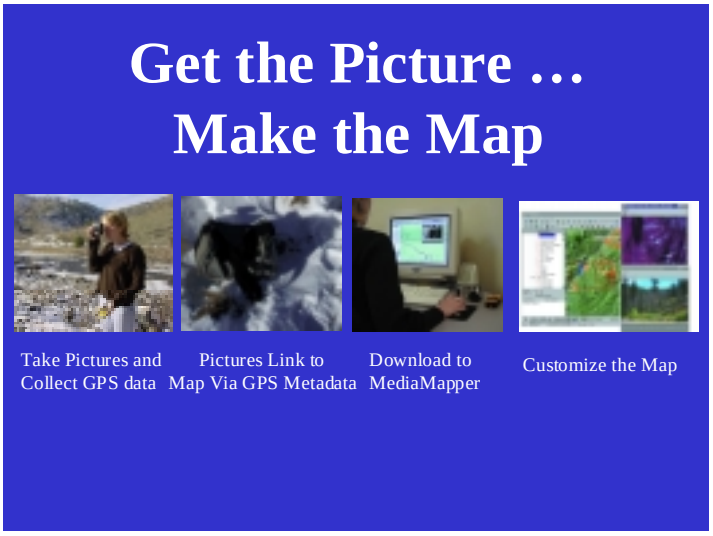

Fig. 6

The other option is to use a digital camera with integrated GPS/WAAS card and the software allows creation of data dictionary also.(see Fig7)

Fig.7

SELECTION CONSIDERATIONS

GPS RECEIVER CONSIDERATION

The most important criteria in selecting a GPS receiver is identifying the accuracy that the application requires. The receivers generally fall into 5 categories. Autonomous - 10-15 meters, 1-5 meters, sub meter, decimeter, and survey grade (cm levels). For all with the exception of autonomous category, one needs to decide what level and reliability DGPS corrections are required. Keep in mind some services are free but not always reliable.

DATA COLLECTOR SELECTION CONSIDERATION

The weight and size of the unit is an important factor when using the units in the field for long periods of time. The type of operating system (Palm O/S, Pocket PC, WINDOWS) to be used needs to be considered if integrating with other application platforms. If you require a display of a background map, it will be preferable to have a unit with a larger screen and color display. However, the color display may reduce your battery life. If the application involves use in a rough environment, the data collector selected must be ruggedized for outdoor use. Battery life is also an important factor in the selection of the data collector. The unit selected has to be compatible with the type of GPS receiver and other sensors.

FIELD DATA COLLECTION SOFTWARE SELECTION CONSIDERATION

As certain versions of field data collection software have limited features, several factors need to be considered in selecting the right software.

The selected software should be compatible with the GPS receiver and the operating system chosen for the data collector. Some software packages do not allow you to create and edit features in the field. This restriction implies that for any changes and or additions to the data dictionary, you will have to stop the project in the field and access a PC to edit the dictionary, reload the new version of the dictionary, and restart the field project. This is a very time consuming process which can be avoided by simply selecting the software with field editing of the data dictionary capability.

The software selected must be able to operate on the data collector platform selected. All the new Pocket PC software for PDA'S may not run on each and every PDA. Ensure that the software selected has various options for choosing different datums and projections. Make sure you have the option to collect POINT/LINE and POLYGON features. In the line or Polygon features the software should allow for automatic data collection by time or distance intervals. The software should be able to display quality of reading data such as DOP values. If data has to be outputted to various different formats such as shape, DXF, Text, etc, make sure that the software that is selected is capable of exporting data in these formats.

LASER RANGE FINDER SELECTION CONSIDERATION

If you need to collect large amount of data and in areas, which are difficult to reach, or GPS readings are not available, a laser range finder will be a very useful tool. In areas where you encounter magnetic fields, a angle encoder will be a better choice of a compass than a fluxgate compass which gets affected by the magnetic fields.

CONCLUSION

The trend towards better price /performance ratio will continue and the trend towards smaller, lighter, cheaper will continue in the mapping markets. Due to lower prices and easy availability of more accurate systems, users are now leaning towards procuring more accurate GPS systems. Users are now setting their sights on decimeter level accuracies rather than sub meter levels which for several years has been a sort of standard for mapping grade projects.

No doubt the availability of newer products and software has allowed the users to have a wide range of selection choices but that itself is causing users to end up making incorrect or less than optimal choices. With more options and wide pricing range, coupled with easier availability of this technology, the users have to be extremely careful when planning and implementing their Mobile Mapping project.