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Geomatics as a tool for intelligent transport system; Fleet Management System in Jordan as a demonstration

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Abstract

Geomatics has become a widespread field with many other disciplines using techniques such as GIS and remote sensing. The Fleet Management Ssystem (FMS) is comprised of many disciplines, from hardware/software engineering, technical communications and network that to provide a fast and reliable satellite communication. The Fleet Management System hosted by web application to assist companies with large fleets to efficiently conduct and coordinate their operations. The article has been made to demonstrate implementing and integrating geomatics elements; GPS, GIS, and remotely sensed satellite images as a source of information. FMS in Jordan has been selected to be presented as a demonstration; because it had the most novel solution that could meet the needs and designed in very vigorous, flexible and acceptable way to create an adaptable system that can be implemented in vehicles. The friendly user system can be implemented in any type of vehicles.

Keywords: Geomatics, Fleet Management Ssystem, Global Positioning System, Geographical Information System, remotely sensed satellite images.

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Introduction:

Geomatics as adopted by the International Standards Organisation (ISO) is as follows: “Geomatics is a field of activity which, using a systematic approach, integrates all the means used to acquire and manage spatial data required as part of scientific, administrative, legal and technical operations involved in the process of production and management of spatial information. These activities include, but are not limited to, cartography, control surveying, digital mapping, geodesy, geographic information systems, hydrography, land information management, land surveying, mining surveying, photogrammetry and remote sensing.” Fleet management system (FMS) is consists of GPS tracking device that uses customized software to keep constant track of all the vehicles in the fleet. Fleet management is a technological mix of GPS (Global Positioning System) with two-way wireless set, an on-board processor, and a hosted web application that demonstrates mapping and vehicle telemetric data to the end user. The GPS tracking system helps the transportation companies in locating their vehicles and monitoring their speed and direction. A fleet management system is important function for any public transportation such as buses, this involves scheduling and planning of routes and at the same time ensuring that the buses run as per the schedule. This becomes exceptionally difficult in bigger cities where the number of buses involved is very high and all these buses perform repetitive trips. The failure of management in ensuring timely operations has resulted in the bus system becoming unpopular and shift in traffic to the personalized modes of transport. However GPS based intelligent transport systems provide the possibility of monitoring the movement of vehicles at an affordable cost (Pradeep 1999).

The efficient vehicle system would require the integration of all modern technologies such as: the Global Positioning System (GPS), the Geographical Information System (GIS) and remotely sensed satellite images (RS). Fleet Management system combines GPS technology with two-way satellite communications to design, manufacture and deliver complete mobile equipment tracking and GPS management systems. FMS provides useres with solutions that

deliver measurable improvements in asset utilization, safety and security, and labor productivity while reducing the risk of theft and cost of recovery.

Fleet Management System in Jordan as a demonstration has been selected and evaluated because it had the most novel solution that could meet the needs and designed in very robust, flexible and acceptable way to create a user-friendly and adaptable system, that in order to emphasize on the role of geomatics elements as an important tools in sach System.

1.1 objectives:

The objectives of this study are:

1. To evaluate Fleet Management System in framework of geomatics elements: GPS, GIS, and remotely sensed satellite images.

2. To demonstrate the Fleet Management System as intelligent transport system provide the possibility of monitoring the movement of vehicles and helps the transportation companies in locating their vehicles and monitoring their speed and direction.

1.2 Methodology:

In this study the integration between several geomatics elements: the Global Positioning System (GPS), the Geographical Information System (GIS) and remotely sensed satellite images (RS) will be discuse and evaluated as shown in the flow chart below. FMS in Jordan has been demonstrated as intelligent transport system. The resultant maps and layouts wil be also evaluated.

1. Global Positioning System (GPS):

GPS was developed by the US Department of Defense for military use, but the system was made accessible for civilian use under their presidency of Ronald Reagan in the 1980s. The first satellite was launched in 1978 as part of a strong experimental system but a second

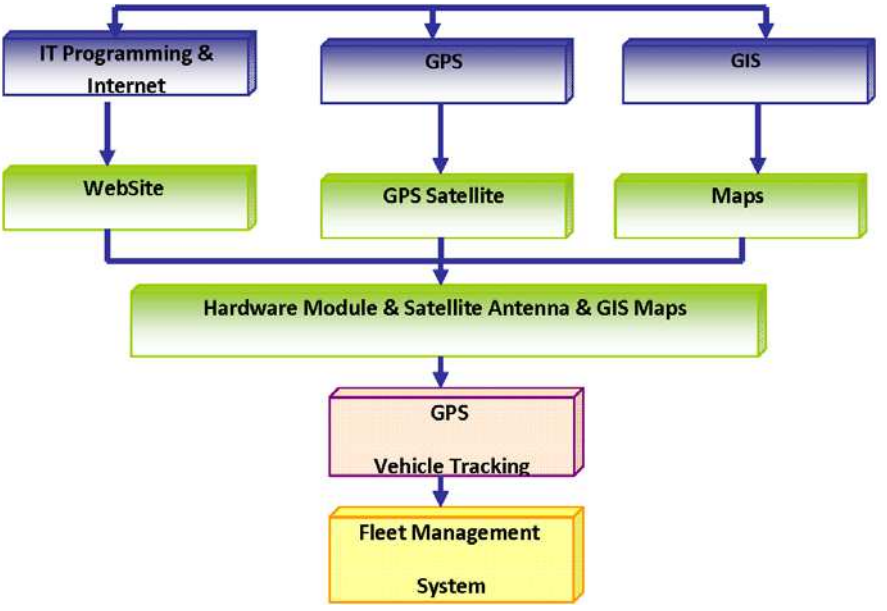

Figure 1. The integration between geomatics elements: (GPS), (GIS) and remotely sensed satellite images (RS) in Fleet Management System.

phase of launches between 1989 and 1994 built of the success of the experimental network and has resulted in the present day constellation of 24 satellites (Hoffmann, 1994). Each satellite is expected to last for up to ten years. Now by using GPS the user can determine positions on and above the earth and its oceans using suitable satellite receiving equipment .The receivers on the earth can calculate their positions with high precision by determining their distance from four or more satellite (Kaplan, 1996).

2.1 The GPS satellite system:

The 24 satellites that make up the GPS space segment are orbiting the earth about 2,000 miles above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are traveling at speeds of roughly 7,000 miles an hour.

GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path (Dagfinn, 2006).

2.2 Tracking Devices:

One of the easiest applications to consider is the simple GPS tracking device; which combines the possibility to locate itself with associated technologies such as radio transmission and telephony. Tracking is useful because it enables a central point to monitor the position of several vehicles or people, in real time, without them needing to relay that information explicitly. This can include children, criminals, police and emergency vehicles or military applications. The tracing devices themselves come in various different flavors. They will always contain a GPS receiver, and some GPS software, along with some way of transmitting the resulting coordinates. GPS watches, for example, tend to use radio waves to transmit their location to a tracking center, while GPS phones use existing cell phone technology (Salehi, 2008).

The tracking center can then use that information for co-ordination or alert services. One application in the field is to allow anxious parents to locate their children by calling the tracking station – mainly for their peace of mind. GPS vehicle tracking is also used to locate stolen cars, or provide services to the driver such as locating the nearest gas station. Police can also benefit from using GPS tracing devices to ensure that parolees do not violate curfew, and to locate them if they do (Zito, 1995).

2.3 Navigation Systems:

Once we know our location, we can, of course, find out where we are on a map and GPS mapping and navigation is perhaps the most well-known of all the applications of GPS. Using the GPS coordinates, appropriate software can perform all manner of tasks, from locating the unit, to finding a route from A to B, or dynamically selecting the best route in real time. These systems need to work with map data, which does not form part of the GPS system, but is one of the associated technologies that we spoke of in the introduction to this article. The availability of high powered computers in small, portable packages has lead to a variety of solutions which combines maps with location information to enable the user to navigate. The first such application was the car navigation system, which allows drivers to

receive navigation instructions without taking their eyes off the road, via voice commands. Usually, these systems take their map data from a CD which can be replaced when the driver moves from one geographical location to another (Jurgen, 1998).

3.4 Vehicle tracking system:

There are several different types of the GPS vehicle tracking system, from which you can choose the one that best fits your own personal or business needs. These include the wireless GPS tracking system, the entry-level GPS tracking unit, and the advanced GPS tracking system. The wireless GPS tracking system is the option which provides you with fast and easy access to the essential information that you really need. It is combined with extensive GPS tracking software, and automatically delivers detailed Fleet racking and the reporting of data.The entry-level GPS tracking unit is different, in that it is designed for fleets that have basic vehicle tracking needs; this option shows such components as vehicle location, route, stops, and speed.
A vehicle tracking system is an electronic device installed in a vehicle to enable the owner or a third party to track the vehicle's location. Most modern vehicle tracking systems use Global Positioning System (GPS) modules for accurate location of the vehicle. Many systems also combine a communications component such as cellular or satellite transmitters to communicate the vehicle's location to a remote user. Vehicle information can be viewed on electronic maps via the Internet or specialized software (The Global Security Tracking AVL series, 2007).

3. The significance of GIS in Fleet Management System:

Geographic Information Systems (GIS) have been in use for presentation, analysis, distribution and the store of spatial data all making for easier and more efficient business planning, management and realization. Traditionally GIS has been used in environmental protection, defiance, telecommunications, police, cadastre, management of real estates and infrastructure and, more recently, in so called Intelligent Transport Systems (ITS) and logistics. At the beginning "primitive" routing, by means of measuring distances with

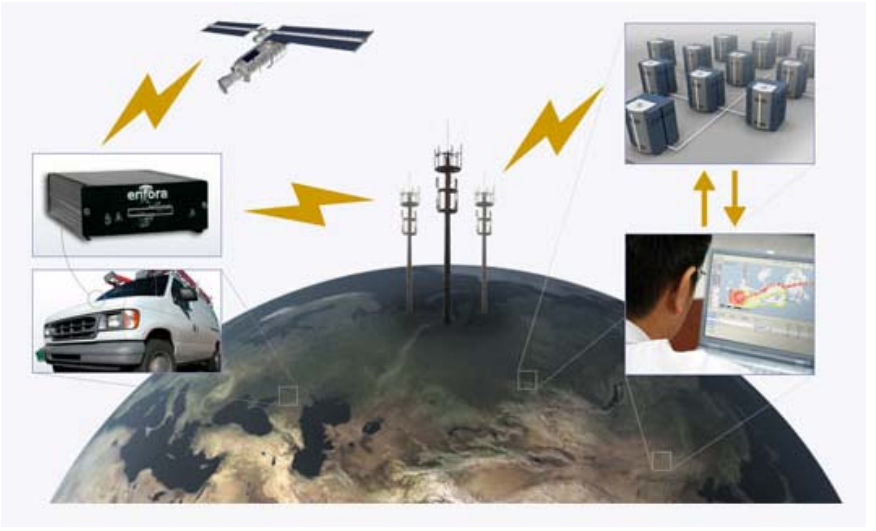

Figure 2. How GPS Tracking Works

ruler and caliper on paper map existed. Today a number of GIS applications for transport and logistics exist - and the number is rising. GIS has been use daily and worldwide for the efficient connection, harmonization and management of all transport processes in an ever rising number of companies. Solutions, such as intelligent routing plan, satellite fleet management, distribution area planning and management of infrastructure resources are just a few examples in a wide palette of GIS supported solutions for transport and logistics (Reddy, 2007).

The Global Positioning System (GPS) is a satellite system that provides precise location by using special GPS receivers. This accurate GPS information is of limited use by itself, except if it is attached with a powerful visualization tool like the Geographic Information Systems (GIS). The GIS is a visualization tool that presents data and information in a graphic shape that is a suitable means of communicating compound information. These systems also have many of relevant spatial and non-spatial data as diverse layers of information that can be shown as a map or a layer. Therefore, the integration of GPS and GIS brings into reality a powerful tool that has location and visualization.

Digitization the road map of the city is the first step and the most important element in fleet management system, detect precise location using special GPS receivers is the second step, then the integration of geomatics elements (GIS and GPS) to brings into reality a powerful tool that has location and visualization is the last step.

4. The uses of fleet management system in Jordan:

The pioneer company that uses FMS in Jordan is Erada Company. Erada was established in 2004 and committed to build values not only for customers and business, but also for the communities. Erada use the Starcom system; that is a full cellular (GSM CDMA) and location (GPS) system solution includes both software and hardware set to provide the perfect vehicle tracking system for every place. Starcom operates around the world for over 14 years to establish and support operational centers for various applications, including: fleet and asset management, vehicle and driver protection (security and medical protection), high value merchandise location, and people location**.**

4.1 Fleet tracking system:

- Fleet management operates around the world for over 4 years to establish and support operational centers for various applications, including: fleet and asset management, vehicle and driver protection (security and medical protection), high value merchandise location, and people location. The fleet tracking system in Jordan is a friendly and easy-to-use system, which has unique advantages that are not available on any other systems, for an organization wishes to improve its fleet management and needs real-time solutions. Fleet Management application gives the fleet manager and the employees the flexibility and independence for planning and managing the vehicles fleet, its logistics organization, and the database management (Erada for E-solutions Co., Ltd. 2009).

4.2 The Vehicles protection:

The Interpol statistics and data show that the rate of car theift is increasing. Vehicle thefts cost insurance agencies and car owners

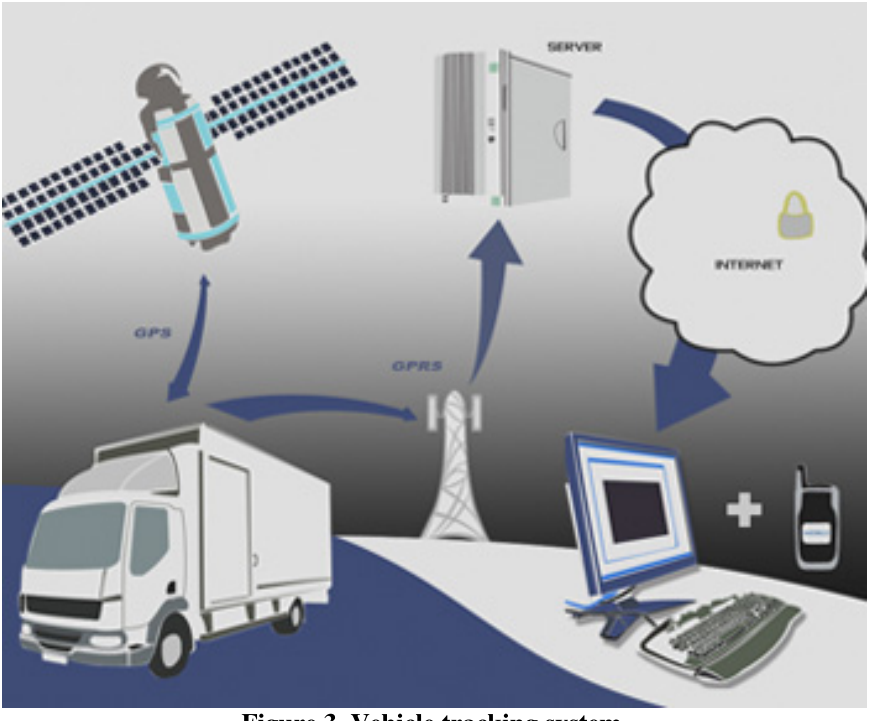

Figure 3. Vehicle tracking system.

billions of dollars in damages each year. (See figure 4). The System is specifically designed to detect and minimize losses due to criminal activities. The system is designed to report events automatically and in real-time, for quick response. The control center focus is to support the client 24/7, by responding in a timely, responsible and professional manner for a routine or emergency situation: kidnapping situations, accident events, and more.

All the operators are following the established procedures and act in the best interest and well being of each client while keeping the client's Right to Privacy. The system is synchronized between the hardware, the software and the client's mobile phone, to enable the client to send commands to his vehicle, receives his vehicle location and statuses and receives any required alert from the vehicle in friendly and easy to use application**.** The System puts the control at the client's fingertips and makes connection with the internet and

handheld navigation available via the hardware (Erada for E-solutions Co., Ltd. 2009).

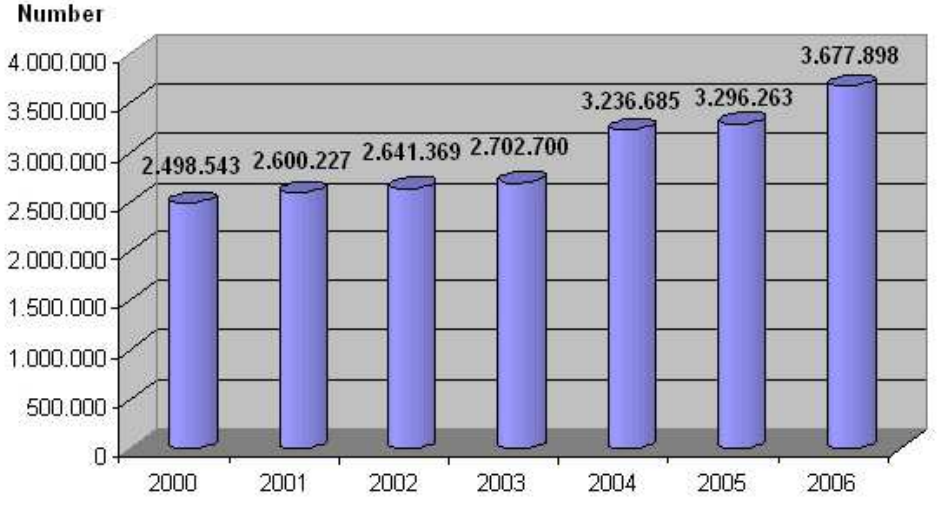

Figure 4. The interpole ststistics and data show that the rate of car theift is increasing.

4.3 Fleet Key Features:

Programmable Events: Events can be defined to both transmit and act on complex events. For example – activating the horn and transmitting when a tanker truck activates its engine while unloading fuel at the fuel depot. Speed restrictions: Programmable alerts whenever the vehicle goes above/below a Pre- defined speed, to detect over hastiness, and unauthorized stops Mileage: Ability to alert every specific number of kilometers.

Motor is running while stationary: Alert when the motor is running and the vehicle is left stationary at a specified time range.

Perimeter based alerts: Geo-fencing alerts when a vehicle is entering/leaving/not entering/not leaving a specified a designated area at a specified time. Values Monitoring: Monitoring of analog inputs to alert when voltage/temperature are exceeding.

Driver Identification: By using different Dallas I Button, Remote Controls, or Keypad Codes, the unit sends the code of the current vehicle driver to the center.

Mileage Transmissions: Periodic mileage transmissions for the needed vehicle's maintenance Automated Tracking: Automatic support for vehicle tracking at specified time, without sending additional commands to the vehicle.

Unauthorized Code Alert: Alert when unauthorized code has been used by an unauthorized disarming device. Gradual Stop: Option to gradually stop the vehicle by sending pulses to the immobilizer or fuel pump (Erada for E-solutions Co., Ltd. 2009).

4.4 Vehicle and Driver Protection:

Emergency Button: Support for emergency button to invoke an immediate high-priority transmission to the center. Accident and Harsh.

Braking Detector: Built-in accelerometer serves as both accident and a harsh braking detector.

Auto Lock: Support for locking/unlocking the doors whenever the motor is starting / stopping (Erada for E-solutions Co., Ltd. 2009).

5. Demonstration for the fleet tracking system:

In the following is an example of how the system works, that provided by Erada Company:

1. Enter the home page of web site then input user name and password. (Figure 5).
2. Report type choices; work hours, specific are over speed and data vehicle. (Figure 6).
3. Select the report name, work hours, vehicle number driver name the data and the time. (Figure 7).
4. Diagram shows the rate of the total work. (Figure 8).
5. Vehicle location on map with street names (the current site is in sahra Mosharafa Street). (Figure 9).
6. Vehicle information table: vehicle symbol, name site, speed. (Figure 10).
7. Report shows the details of the vehicle. (Figure 11).
8. The details of the vehicle illustrated on a map. (Figure12).
9. The details of the vehicle illustrated on a sataellite image. (Figure13).

Figure 5. The home page of web site.

Figure 6. Report type choices; work hours, specific are over speed and data vehicle.

Figure 7. Templet of the report name, hours, vehicle number driver name the data and the time.

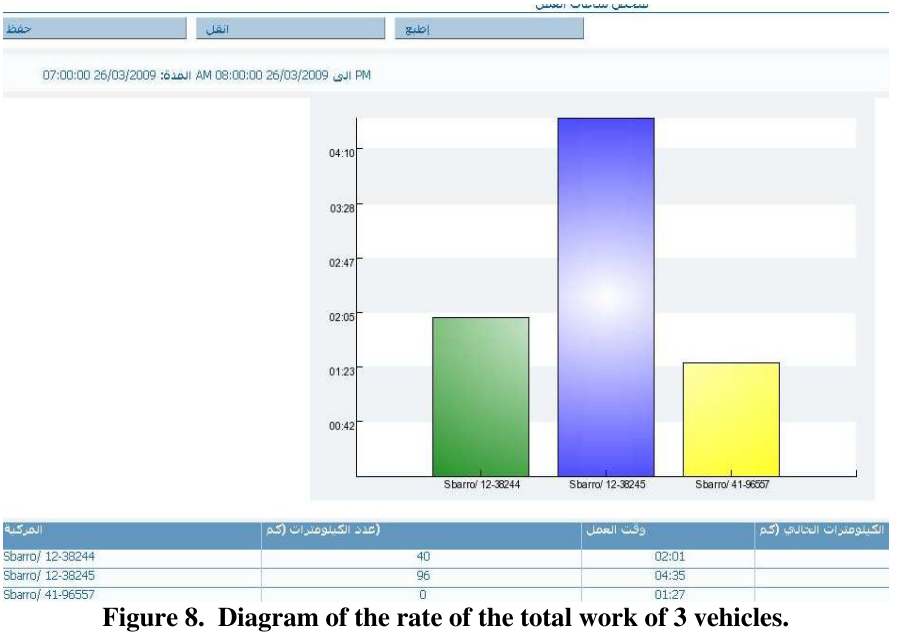

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Figure 8. Diagram of the rate of the total work of 3 vehicles.

Figure 9. Vehicle location on map with street names.

Figure 10. Vehicle information table: vehicle symbol, name site, speed.

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26/03/2009 04:22:46 PM (منطقة زهران, شارع الملك فيصل بن عبد العزيز 35.8709,31.9657)	26/03/2009 04:32:50 PM (منطقة تلاع العلي وأم السماق و خلدا, شارع عبد الله الداوود 35.8420,31.9771)
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26/03/2009 06:28:41 PM (منطقة الجبيهة, شارع عاكف الفايز 35.8845,32.0156)	26/03/2009 06:48:49 PM (منطقة تلاع العلي وأم السماق و خلدا, شارع عبد الله الداوود 35.8420,31.9773)
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Figure 11. Report shows the details of the vehicle.

Figure12. The details of the vehicle illustrated on a map.

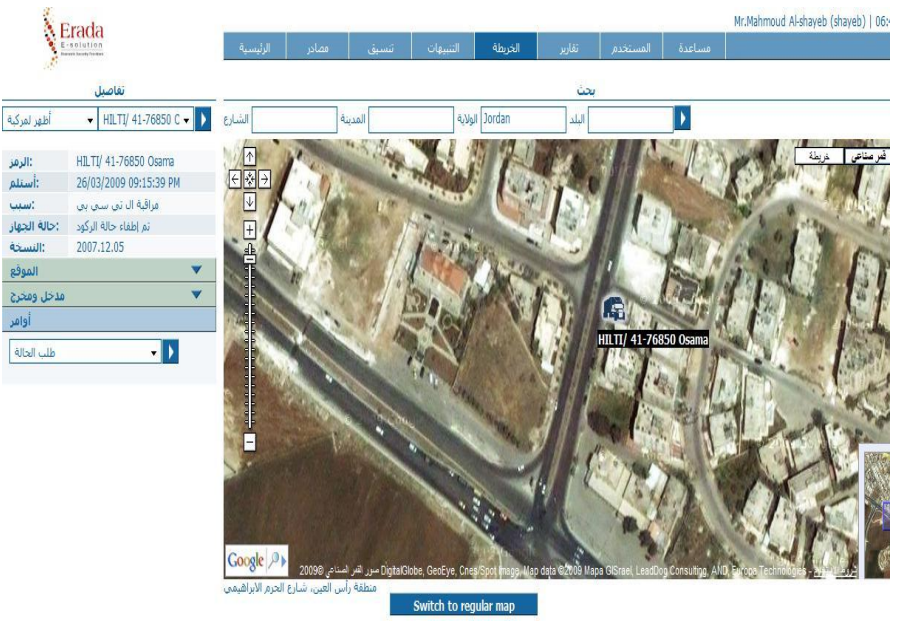

Figure13. The details of the vehicle illustrated on a satellite image.

6. Conclusions:

Fleet management is a technological mix of GPS (Global Positioning System) with two-way wireless set, an on-board processor, and a hosted web application that demonstrates mapping and vehicle telemetric data to the end user. The implementation and the integration of geomatics elements; GPS, GIS, and remotely sensed satellite images as a source of information has been demonstrated in this article.

Vehicle thefts cost insurance agencies and car owners billions of dollars in damages each year; ststistics show that the rate of car theift is increasing. The Fleet management system is specifically designed to detect and minimize losses due to criminal activities. The system is designed to report events automatically and in realtime, for quick response. A fleet management system is important function for any public transportation such as buses, this involves scheduling and planning of routes and at the same time ensuring that the buses run as per the schedule.

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الجيوماتكس كأداة لنظام مواصلات ذكي: نظام إدارة أسطول المركبات في الأردن كحالة عرض

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ملخص

أصبح علم الجيوماتكس منتشراً وذلك كونه يتألف من العديد من التخصصات مثل والاستشعار عن بعد ونظم المعلومات الجغرافية ونظام تحديد المواقع العالمي. ويتألف نظام إدارة أسطول المركبات من الأجهزة والبرامج، والاتصالات التقنية وشبكة الاتصالات لتوفير المعلومات بطرق سريعة وموثوق بها. إن نظام إدارة أسطول المركبات من خلال تطبيق خدمة الويب قد ساعد الشركات التي لديها أساطيل كبيرة على السيطرة عليها من اجل إدارتها بكفاءة. يعرض البحث طرق تنفيذ ودمج عناصر القياس؛ لتحديد المواقع ونظم المعلومات الجغرافية والاستشعار عن بعد صور الأقمار الصناعية كمصدر للمعلومات. وقد تم اختيار نظام إدارة أسطول المركبات في الأردن لتقديمها كحالة عرض، لأنه الحل الذي يمكن أن يلبي احتياجات إدارة أسطول المركبات وإدارتها بكفاءة عالية. ويمكن تطبيق هذا النظام سهل الاستخدام في أي نوع من المركبات حيث يمكن تسهيل الإدارة من اجل زيادة الإنتاجية من خلال جدولة أفضل لنظام إدارة أسطول المركبات، بالإضافة إلى تعزيز سلامة السائق وحماية الأصول.

كلمات المفاتيح: علم الجيوماتكس، نظام إدارة أسطول المركبات، نظام تحديد المواقع العالمي، الاستشعار من بعد، نظم المعلومات الجغرافية، صور الأقمار الاصطناعية.