DOKUZ EYLÜL UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

PUBLIC VEHICLE TRACKING SYSTEM APPLICATION WITH GIS

by

Orhan Fatih AKÇA

September, 2013

İZMİR

PUBLIC VEHICLE TRACKING SYSTEM APPLICATION WITH GIS

A Thesis Submitted to the
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In Partial Fulfillment of the Requirements for the Degree of Master of Science
in Geographic Information System, Geographic Information System Program

by

Orhan Fatih AKÇA

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İZMİR

M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"PUBLIC VEHICLE TRACKING SYSTEM APPLICATION WITH GIS"** completed by **ORHAN FATİH AKÇA** under supervision of **PROF.DR. VAHAP TECİM** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

Prof.Dr. Vahap TECİM

Supervisor

Prof. Dr. Koray KARALİOĞLU

(Jury Member)

Yrd. Doç. Dr. Güven KOÇAK

(Jury Member)

Prof.Dr. Ayşe OKUR
Director
Graduate School of Natural and Applied Sciences

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PUBLIC VEHICLE TRACKING SYSTEM APPLICATION WITH GIS

ABSTRACT

In Turkey, there are a lot of vehicles on public institutions. These vehicles are directed by a head Office within the institution as fit in the purpose of public institutions if needed. Due to the fact that there are a lot of vehicles contained to the institutions and these vehicles are allocated to depend on the task, management problems occur.

The aim of this thesis is to find GIS (geographical information systems)-based solution related to the management of vehicles contained to state universities. Therefore, a software which uses digital maps and spatial data effectively has been prepared in this thesis. System applied for using of the vehicles that Dokuz Eylul University which is a field of examination and implementation has have been considered.

The principles of using public vehicles, their structure within the field and the structure of law related to them have been examined for the purpose of this thesis. The technology which is necessary to reach location data needed for vehicle tracking and management of vehicles and also to reach digital map data has also been examined. The appropriate service provider has been analyzed for the use of online digital maps. The suitable systems for application development area have been determined by analyzing computer programming languages that are available on the market and also analyzing Technologies of database management systems for the effective use of online digital maps and location data. The structure of the application software that is suitable for the purpose has been described in the structure of the specified system.

Data entries of location data of the organization and its staff and tools are taken by dint of application prepared to track and manage the public vehicles. Locations of the vehicles are displayed instantaneously. The information entered, assignments and

location data received from GPS (Global Positioning System) are reported by correlating on digital maps. Seeing a combination of environmental conditions and vehicle positions, the system administrator will take a right decision thanks to application prepared.

Keywords: Geographical information systems, GPS, online digital map, public vehicles, vehicle tracking, relational database, location data, computer programming languages

CBS İLE KAMU ARAÇ TAKİP SİSTEMİ UYGULAMASI

ÖZ

Ülkemizde kamu kurumlarına bağlı birçok araç bulunmaktadır. Bu araçlar kamu kurumunun hizmet amacına uygun olarak kurum içerisinde bir merkez tarafından ihtiyaca göre yönlendirilmektedir. Kurama bağlı birçok aracın olması ve bu araçların göreve bağlı olarak tahsis edilmesi beraberinde bir yönetim sorununu oluşturmaktadır.

Tezin amacı Devlet Üniversitelerin bünyesinde bulunan araçların yönetimi ile ilgili sorunlara CBS (Coğrafi Bilgi Sistemeleri) tabanlı çözüm bulmaktır. Bunun için tez kapsamında sayısal haritaları ve mekânsal verileri etkili bir şekilde kullanan bir bilgisayar yazılımı hazırlanmıştır. Uygulama ve inceleme alanı olarak Dokuz Eylül Üniversitesinin yapısı ve bünyesindeki araçların kullanımı için uyguladıkları sistem göz önüne alınmıştır.

Tez çalışmasının amacına uygun olarak kamu araçlarının kullanım ilkeleri, çalışma alanı bünyesindeki yapısı ve ilgili kanun yapısı incelenmiştir. Araç takip ve yönetimi için gerekli olan konum verisi ve sayısal harita verisine ulaşmak için gerekli teknojoli yapısı incelenmiştir. Online Sayısal harita kullanımı için uygun servis sağlayıcının yapısı incelmiştir. Sayısal haritaların ve konum verisinin etkin olarak kullanımı için piyasada bulunan bilgisayar programlama dilleri, veritabanı yönetim sistemeleri teknolojileri incelenerek uygulama geliştirme alanı için uygun sistemler belirlenmiştir. Belirlenen sistem yapısı içerisinde amaca uygun uygulama yazılımın yapısı anlatılmıştır.

Kamu araçlarını takibi ve yönetimi için hazırlanan uygulama ile kurumun konum verlerinin, kurum personelinin ve kuruma bağlı araçların bilgi girişi yapılmaktadır. Araçların anlık konumları görüntülenmektedir. Girilen bilgiler, görevlendirmeler ve GPS (Global Positioning System) den alınan konum verileri ilişkilendirilerek sayısal

haritalar üzerinde raporlamalar yapılmaktadır. Hazırlanan uygulama ile sistem yöneticisinin çevre koşullarını ve araç konumlarını bir arada görerek doğru karar vermesi sağlanmaktadır.

Anahtar kelimeler: Cografi Bilgi Sistemleri, GPS, çevrimiçi sayisal harita, kamu araçları, araç takip, ilişkisel veri tabanı, konum verisi, bilgisayar programa dilleri

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CHAPTER ONE
INTRODUCTION

1.1 Research Objectives

Spatial data enters the social lives quickly with the recent technological development. Today, mobile phones and tablet computers include built-in GPS receivers as standard hardware. Reliability and speed of GPS connection is still an active research area and development continues with an increasing momentum. With such developments, navigation software is prepared for various platforms and it is becoming widespread. Digital maps are published on the internet by many service providers (Google, Yahoo, Microsoft Bing, Nokia, MapQuest, Open Layer etc.) and opportunities are provided to use them effectively. Accordingly, location-based customization is becoming a common feature of social networking.

Experts and developers working in different sectors and that are members of different disciplines started to use spatial data in order to plan their works prepared in a better way and also to offer them in a more effective way. Spatial data is used as the main element to interpret efficiently and to be understood of environmental factors.

It is possible to monitor vehicle fleets on digital maps with increasing availability of digital maps and the development of GPS technology. GSM and private companies working on the subject particularly (Turkcell, FiloTürk, Arvento etc.) has been developing systems to monitor individual vehicles or the existing vehicles of institutions. These systems provide report of a combination of routing, scheduling and relational data to the administrators and the users. Prepared vehicle tracking system software is developed as monitoring of commercial and individual vehicles and reporting of location data obtained. Program development editors on diverse platforms prepared to use of Web masters and computer programmers are organized so as to allow the use of spatial data.

The aim of this thesis is to ensure monitoring, reporting and planning the use of vehicles in the public institutions on the digital maps by the administrators. Therefore, the public vehicles tracking system has been generated in accordance with the use regulation and implementations of public vehicles. Checking, monitoring, assigning in accordance with service and preparing reports required by the institutions so as to be monitored by administrators through the data obtained of vehicles are intended with the vehicle tracking system prepared. Dokuz Eylül University is selected as case institution within this study. The Windows-based vehicle tracking system has been prepared by examining the needs of Dokuz Eylül University.

1.2 Thesis Structure (Organization of the Study)

The Thesis consists of five chapters organized as following:

CHAPTER TWO: Use of vehicles in the public sector. In this chapter, the content of the law organizing the use of public vehicles has been examined. The use applications of vehicles within Dokuz Eylül University have also been examined and the emerging problems have been analyzed.

CHAPTER THREE: The technologies and computer softwares used to the public vehicle tracking system application. The structure and development of the GPS system have been described. The structure of the digital map provider and the use of digital maps needed for the vehicle tracking system to display the location data obtained have been examined. Also, the database and the structure of computer programs used in the development of public vehicle tracking system have been examined.

CHAPTER FOUR: Case study. The development stages of the public vehicles tracking application have been described. The instruction of the prepared application has been clarified in detail.

CHAPTER FIVE: Conclusion. In this chapter, a summary of this study and the benefits that will be obtained as a result of the vehicle tracking application have been presented.

CHAPTER TWO
USE OF VEHICLES IN THE PUBLIC SECTOR

2.1 The Regulations On The Use Of Public Vehicles – The Law

Civil servants cannot remove any official documents, vehicles and tools out of duty and they cannot use them for personal work. In addition, civil servants deliver all kinds of official documents, vehicles and tools used during the official duties to their places after the completion of the duty (Article 16 of Law No. 657).

The use of public vehicles is regulated with law no. 237, dated 01.05.1961, and with the prime ministry's circulars no. 2001/23 and 2001/29. Provisions such as the number of vehicles that a public institution can have, which conditions the public vehicles can be used in, budget arrangements about driving, buying new cars and selling of existing vehicles, color of plates of vehicles, any words on the vehicles are described. When the use out of limits stated in the law, who will be responsible for and what penalties will be is also indicated with Article 16 (Amended: 23/1/2008-5728/285 art.). All of the vehicles that are charged authority and others can be used according as the provisions of these law and circulars.

According to the article of the law and the published circular, in certain cases, public vehicles should be used by authorized drivers and they should be left to the parking determined by the institution after using. The conditions that the public vehicles should not be used are indicated in the circular clearly. Except the cases specified by the law and regulation, public vehicles may not be used and they must be supervised to detect these cases. To use the vehicles in public institutions in budget facilities, renew, repair and compulsory visa and insurance procedures need to be done on time. The necessary measures should be taken to keep the use of fuel-oil in a minimum level. To ensure this, public vehicles must be continuously monitored by the institution that they are attached to.

2.2 The Existing Implementation About Using Of The Public Vehicles

In public institutions, there are a lot of different implementations about the use of vehicles allocated to the authority or specific people and the use of other vehicles depending on the structure and organization of public institutions. The use of vehicles within Dokuz Eylül University as the study area has been examined. The output of a computer-generated template is taken to be able to use the vehicles within the institution on a specific task. The prepared template is as shown in Figure 2.1 The template prepared for the commissioning order includes the information about the staff and supervisor that the public vehicles are allocated to, the information of the assigned driver, the information of vehicles that will be used on the task, the information of the head of department assigning the vehicles and the information of the location to go. This information is completed by the individuals concerned. At the end of the specified assignment, the warrant of task is filed and it is delivered to the related officer.

DOKUZ EYLÜL ÜNİVERSİTESİ Sıra No:
DESTEK HİZMETLERİ ŞUBE MÜDÜRLÜĞÜ
TAŞIT GÖREV EMRİ Tarih: ...../...../200....

Görevli Birim Amirinin			Aracın
Adı Soyadı	Ünvanı	İmzası	Sürücüsünün Adı Soyadı
Görevli Personelin			Plakası
Adı,Soyadı, Ünvanı			
Görev Türü			Ait Olduğu Kuruluş
Gidilecek Yer			Aracın Kilometresi
			Çıkış km
			Giriş km
Aracı Sevk Eden Birim Amirinin			Aracın
Adı Soyadı	Ünvanı	İmzası	Çıkış Saati
			Giriş Saati

1- Taşıt Görev Emri her görevlendirmede iki nüsha doldurulacak, bir nüshası kurumda kalacak, ikinci nüshası araçta bulundurulacaktır.
2- Taşıt Görev Emri yetkililerin istemesi halinde gösterilecektir.
NOT : Araç sürücüleri ile araçta bulunan görevliler resmi sıfatın gerektirdiği saygınlığa uygun davranışlarda bulunacaktır. Sürücüler görev süresince araç içinde sigara içmeyeceklir.

Form No:GNS.04.035
Yayın Tarihi/Rev: 12.02.2007/0

Figure 2.1 Vehicle task order

Office software is used on computer for the entry of data about the vehicles of institutions, preparing lists and the generation of reports. The lists specified on circular No. 2001-23 and 2001-29 are created by civil servants in charge. General information about the vehicles within the institution and the vehicles allocated to the authority and parking information about them are kept in a list. A list including the total number of the vehicles available in the institution is kept by the type of them. A list is created for the maintenance of vehicles, the time of visa and insurance and this list is periodically updated. Appropriate actions are provided to be done by checking these lists by civil servants in charge. Monthly and annual reports are created for each vehicle regarding the use of fuel-oil. These prepared reports are formed with the use of vehicle assignment papers and the information obtained from the existing vehicles. Daily, weekly and monthly reports are prepared and filed by the civil servants in charge. The prepared lists and the prepared reports are maintained and inspected on a regular basis depending on the dedicated work of civil servants in charge.

2.3 Problems Encountered In The Use And Supervision Of Public Vehicles

The use of vehicles within the public institutions can be followed by the lists prepared with the declarations of civil servants in charge and with their dedicated work. The allocation and the use of vehicles will be followed with precision by the administrations and according to Article 16 of Law No. 237 the transaction will be made for those who act contrary. (Those who allow the use of vehicles and those who benefit from vehicles.)(Circular No.2001/23) In public institutions, the vehicles within the public institutions must be reportable and auditable to ensure the use of them in accordance with the laws and circulars. In the existing applications, however; the use of vehicles cannot be reported during and after the order of the appointment of public vehicles and the use of them due to the lack of data. To ensure the inspection of vehicles, the necessary data must be obtained and reported by using effective reporting tools. In existing application, there is no possibility to inspect the use of public vehicles effectively. Transactions that should be done periodically for

vehicles is done based on civil servants' regulations and investigations on documents. This situation made with the civil servants' personal effort is a favorable situation for errors and shortcomings. To ensure the most efficient use of public resources, the effective use of public vehicles must be provided by the institution. However, quick access to public vehicles and their assignment information cannot be provided.

The scope of this thesis, public vehicle tracking application has been developed to ensure that the public vehicles are reportable and auditable, and that use them effectively. This application prepared as GIS-based GPS has been used to obtain vehicle position data with the computer program prepared in accordance with the facilities of advanced technology. Windows-based a programming language as an application development tool has been used on computer. Relational database architecture has been used to keep data obtained from computer programming language, data obtained from existing systems of the institution and location data obtained from GPS system. As a means of data entry and reporting, digital data has been used to use webmaster's existing digital maps created by means of Google Map APIs by Google Company. To access these digital maps, HTML or Java Script web-defined application development program languages have been used.

CHAPTER THREE
THE TECHNOLOGIES AND COMPUTER SOFTWARES USED TO THE PUBLIC VEHICLE TRACKING SYSTEM APPLICATION

3.1 Global Position System

Throughout the ages, people sought a reliable way to detect the position and the destination. Nowadays, Global Position System (GPS) is the most common and advanced system in this subject. Although primarily developed for military applications of United States Department of Defense (DoD), this system can also be used in civil applications.

GPS is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on the Earth. Information is provided via an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. System is maintained by the United States government and is freely accessible to anyone with a capable GPS receiver.

Led by United States Department of Defense, there are other systems -either developed or under active development- similar to GPS. Global Navigation Satellite System (GLONASS) is a such system developed by Russia and in active use. In the near future, others like GALILEO by European Union and Compass by China, will be deployed. A satellite navigation system with global coverage may be termed a Global Navigation Satellite System or GNSS.

In order to obtain valid data, GPS requires clean view of sky. It cannot get the precise position information in closed areas, under the water, at the places with a lot of buildings, in cloudy and rainy weather conditions. While vehicle tracking system is being developed, this and similar situations are considered. Thus, editing ability of the vehicle mileage data is granted to the administrators using vehicle tracking system.

3.1.1 History of GPS

The launch of Sputnik in 1957 also marked the beginning of the era of satellite navigation. Initially, the U.S. Navy developed a satellite navigation system called Transit. In 1964 Transit became functional for U.S submarines and went commercial in 1967. However, the system could only be used to calculate the position of low velocity, surface vehicles. To accommodate the need for high dynamic, high velocity vehicles such as aircrafts, GPS was eventually developed based on the concepts for the Transit system (Zheng, 2005).

The first GPS satellite was launched in 1978. The first ten satellites launched were developmental satellites, called Block I. From 1989 to 1997, 28 production satellites, called Block II, were launched. The last 19 satellites of this series of satellites were called Block IIA, which were the updated versions. The initial operational capability of GPS was established in December 1993. The primary system was completed with the launch of the 24th GPS satellite in 1994. In February 1994, the Federal Aviation Agency (FAA) declared GPS ready for aviation use. The third-generation satellite, Block IIR, was first launched in 1997. These satellites are being used to replace the aging satellites currently in the GPS constellation. The IIR(M) series of satellites are an upgraded version of the IIR series, completing the backbone of today's GPS constellation. The "M" in IIR(M) stands for modernized, referring to the new civil and military GPS signals added with this generation of spacecraft. Developed by Lockheed Martin, there are eight IIR(M) satellites: SVN-48 through SVN-50, SVN-52, SVN-53, SVN-55, SVN-57, and SVN-58. The first IIR(M) was launched in September 2005, and the last launch occurred in August 2009. As of August 2013, there were seven healthy IIR(M) satellites in the GPS constellation, with the final one (SVN-49) set to "unusable" status. The IIF series expand on the capabilities of the IIR(M) series with the addition of a third civil signal in a frequency protected for safety-of-life transportation. The "F" in IIF stands for follow-on. Compared to previous generations, GPS IIF satellites have a longer life expectancy and a higher accuracy requirement. Each spacecraft uses a mix of rubidium and cesium atomic clocks to keep time within 8 billionths of a second per day. The IIF series will improve the accuracy, signal strength, and quality of GPS. Developed by Boeing, the

IIF series includes a total of 12 satellites: SVN-62 through SVN-73. The first IIF satellite launched in May 2010. As of August 2013, there were four operational IIF satellites in the GPS constellation. Currently under development by Lockheed Martin, the GPS III series is the newest block of GPS satellites (SVN-74 and up). GPS III will provide more powerful signals in addition to enhanced signal reliability, accuracy, and integrity -- all of which will support precision, navigation, and timing services. As of April 2013, GPS III Satellite Vehicles (SVs) 03-08 are in the Production and Deployment Phase. Future versions will feature increased capabilities to meet demands of military and civilian users alike.



Figure 3.1 GPS III on orbit

GPS is a dual-use, satellite-based system that provides accurate positioning, navigation and timing information to users worldwide. Originally developed by the Department of Defense as a military system, GPS has become a global utility. It benefits users around the world in many different applications, including aviation,

road, marine and rail navigation, telecommunications, emergency response, resource exploration, mining and construction, financial transactions and many more.

3.1.2 Structure Of GPS

GPS satellites broadcast signals from space, and each GPS receiver uses these signals to calculate its three-dimensional location (latitude, longitude, and altitude) and the current time.

GPS system consists of three segments: the control segment, the space segment and the user segment.

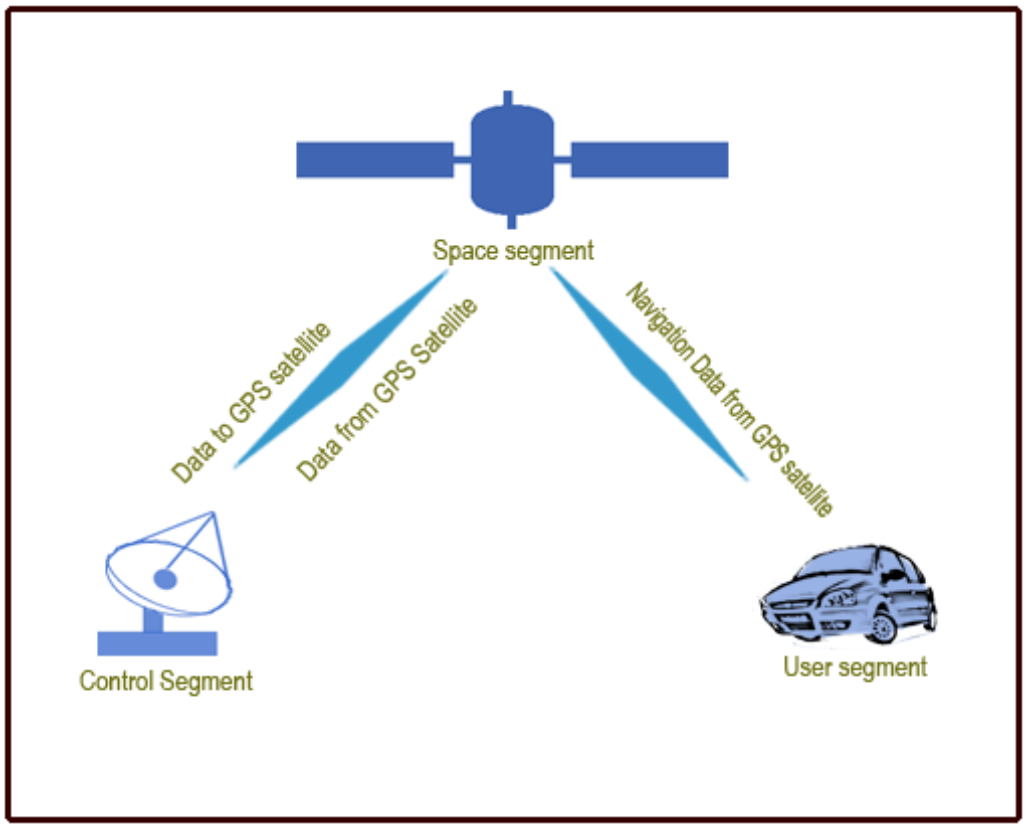


Figure 3.2 TheThree Segments of GPS

The space segment is composed of 24 to 32 satellites in medium Earth orbit. The control segment is composed of a master control station, an alternate master control station, and a host of dedicated and shared ground antennas and monitor stations. The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service, and tens of millions of civil, commercial, and scientific users of the Standard Positioning Service.

3.1.2.1 The Control Segment

The control segment is assembled from a master control station (MCS), four dedicated ground antennas and six dedicated monitor stations. In addition an alternate master control station is included in the control segment. The GPS control segment is a global network that track the GPS satellites and interact with the GPS constellation. 2nd Space Operations Squadron (2SOPS) is located in Colorado and it is responsible from the daily command, control and maintainance of the GPS constellation. 2SOPS ensure 7/24 availability and accuracy of GPS. MCS controls the accuracy and health of the satellites. If a satellite fails, the MCS can reposition satellites in order to obtain an optimal GPS constellation.

Monitor stations observe the GPS satellites and report to the MCS. Monitor stations collect atmospheric data, range/carrier measurements, and navigation signals. 16 monitoring stations are located throughout the World. Ground antennas command and control the GPS satellites. These antennas support S-band communications links that send/transmit navigation data. 4 GPS ground antenna sites are located with the monitor stations at Kwajalein Atoll, Ascension Island, Diego Garcia, and Cape Canaveral. The control segment is connected to the eight Air Force Satellite Control Network (AFSCN) remote tracking stations worldwide.

3.1.2.2 The Space Segment

GPS satellites are located at about 20.200 km altitude. This is also called as Medium Earth Orbit (MEO). Satellites travel around the Earth two times in a day. 6

orbital planes are surrounding the earth. Each orbital plan has 4 satellite slots. Total 24 satellites forms core GPS constellation. Extra satellites might be added to the constellation in order to increase GPS performance. This plane/slot scheme and enhanced satellite placement ensure GPS users receive the most accurate navigation data at any time, at any place around the world.

The space segment consists of the satellites and rockets that launch the satellites. Each orbit has an pitch angle (the angle between the earth's equator and the actual orbit) of 55° to ensure the coverage of the polar regions. The radius of the satellite orbit is 26,560 km and each satellite travel around the Earth two times in a sidereal day. Siderealday is the time for the earth to complete one 360º rotation. The mean sidereal day is 23 hours, 56 minutes, and 4.09 seconds. The satellites can orientate themselves to face toward the sun for power and their antennas toward the earth for transmission.

Table 1.1 lists some of the characteristics of the GPS satellites.

Table 3.1 Characteristics of GPS Satellites

Number of Satellites	24
Number of Orbital Planes	6
Number of Satellites per Orbit	4
Orbital Inclination	55°
Orbital Radius	26560 km
Orbital Period	11 hrs 58 min 2.05 sec
Ground Track Repeat	Sidereal Day

GPS receivers generally track between 4 to 11 satellites at a time. Most GPS receivers track only satellites with an elevation angle greater than 5º. Each satellite has an atomic clock accurate to within three nanoseconds to broadcast signals that are synchronized with other satellites.

Figure 3.3 shows a graphical representation of the GPS satellite constellation.

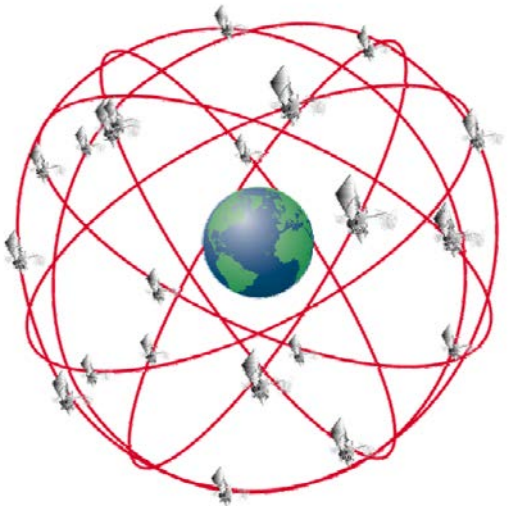


Figure 3.3 GPS Satellite Constellation

The GPS constellation has now attained the most optimal geometry in its 42 year history, maximizing GPS coverage for all users worldwide.

3.1.2.3 The User Segment

GPS is an essential element of the global information infrastructure. GPS is free, open, and dependable. This led to the development of applications affecting every aspect of modern life. The user segment consists of the passive GPS receivers. The receivers evaluate the signals transmitted from the satellites and determine the user position and velocity. The users can be classified into two groups, military and civilian users. The military uses the GPS in a wide range of scope, from navigation tools to target designation, air support to the integration of smart weapons. For the civilian users, GPS is used in many applications such as point-to-point navigation as well as surveying.

3.1.3 GPS Applications

This technique was initially developed for military applications. During 1980, the government decided to make it available for the civilian use as well. GPS has

become an efficient tool in the field of scientific use, commerce, surveillance and tracking. GPS is used except in locations where it is difficult to detect the signal for example, underwater, subterranean location, inside the building and caves.

This Thesis describes just a tiny sample of existing GPS applications. New uses of GPS are invented every day and are limited only by the human imagination.

3.1.3.1 Civilian Applications

· Navigation – Used by navigators for orientation and precise velocity measurements.
·Geotagging – Map overlays can be created by applying location coordinates to photographs and other kind of documents.
·Surveying – Surveyors create maps and verify the boundaries of the property.
· Map-making – Used by civilians and military cartographers.
·Tectonics – Detect the direct false motion measurement in earthquakes.
·Geofencing – Vehicle, person or pet can be detected by using GPS vehicle tracking system, person tracking systems, and pet tracking systems.

3.1.3.2 Military Applications

·Navigation – Soldiers can find objectives in the dark and unknown regions with the help of GPS.
·Search and Rescue – Knowing the position of a downed pilot, its location can be traced out easily.
·Reconnaissance – Patrol movement can be handled.
·Target tracking – Military weapon systems use GPS to track air targets and potential ground before they are flagged as hostile.
·GPS carry a set of nuclear detonation detectors (such as optical sensor, dosimeter, electromagnetic pulse sensor, X-ray sensor) which is a part of United States Nuclear Detonation Detection System.
·Missile and projectile guidance – Targets military weapons such as cruise missiles, precision – guided munitions

3.2 Application Programing Interface (API)

3.2.1 What Is An API

The term API stands for Application Programing Interface and represents, at a high level, a mechanism for code reuse. Code reuse allows programmers to build on top of the work that other programmers (or they themselves) have already done, rather that starting from scratch with every program. The two main forms of code reuse are directly copying code and placing it in one's program - a copy and paste style of reuse - or by calling functions that are packaged up and explicitly intended to be reused. With APIs, programmers can reuse code without needing to modify, understand or even see the implementation, and instead interacting only with the programming interface.

Table 3.2 Different Api-related terms and example for each. In this thesis, we use “APIs” to refer to all of these together.

Libraries	Math library “standard” library in C
Frameworks	.NET Framework, Eclipse Framework
Software Development Kits	.NET Development Kit, Java Development Kit
Toolkits	The GIMP Toolkit (GTK), Google Web Toolkit
APIs	Win32 APIs, Google Map APIs

APIs can enable programmers to create remarkably sophisticated programs with a relatively small amount of work. This is in part because APIs can provide access to large amounts of functionality at a very high abstraction level. For example, using a web-browser widget it is possible to embed an entire web-browser with a single line of code, rather than the tens or hundreds of thousands of lines of code it would take to create this functionality from scratch. This power comes with a price, however, as APIs often limit what programmers can do, and often impose non-obvious constraints on how they need to use the APIs to get a working program. Some APIs however, seem to be much more difficult to use than others, even when the two APIs

provide similar functionality at the same abstraction level. This provides hope that by learning how to make APIs more usable, we can provide powerful yet easy to use abstractions, and make the task of programming easier (Stylos, 2009).

3.2.2 Google Map API

Google Maps is a powerful digital maps application served by Google on the web. Users can access very detailed maps with this web mapping service application. With Google Maps, maps all over the world can be displayed in the desired position, scale and geographical properties. Owing to the data associated with digital maps, searching can be made in any location and this location reached can be positioned. The GPS coordinates of the location reached as a result of search can be also reached. Many applications such as adding a label, identifying routes and reaching location data and photos can be made on Google Maps. Google Maps and webmasters of applications made on Google Maps are allowed to be used on their own sites thanks to the prepared content-rich websites

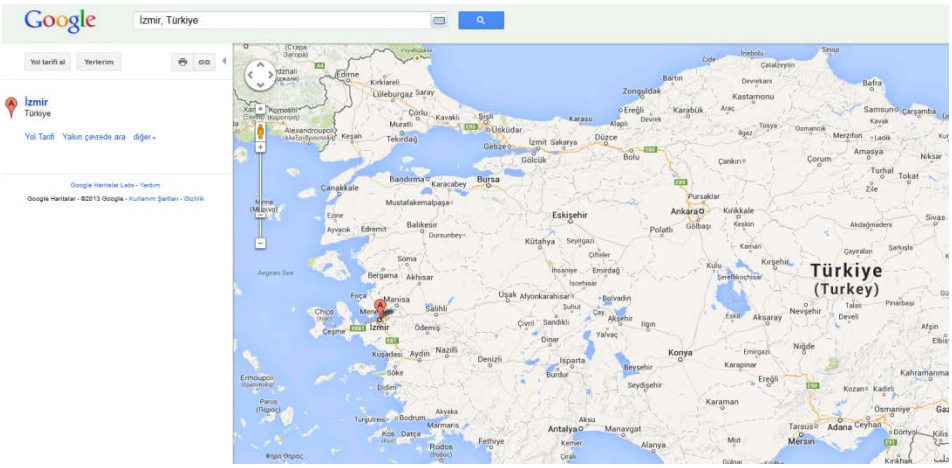


Figure 3.4 Google Map

Companies such as Yahoo, Microsoft Bing, Nokia, MapQuest and Open Layer also offer online map service like Google Map APIs offered by Google. Google Map APIs used on more than 350.000 websites is one of the most popular JavaScript libraries all over the world. Google Map APIs is preferred because it is free for many applications and very common and easy to use. Also, to access the source code is

simple. Google offers different APIs for different systems (iOS, Web, Android). That’s why, the Google Maps APIs was used on the application that we prepared the scope of this thesis.

3.2.3 Google Map API Aplications

Having the desired appearance and properties can be provided to maps added to website as using Google Map API with specified parameters. A simple-looking map can be created and regulation of this map can be provided by specifying the desired attributes. Specifying the data used in the map (like "basic map properties, events, controls, styles, overlays, layers, map types, services"), maps that can carry out with the desired structure and properties can be generated with Google Map APIs.

Please add the following JavaScript code to add a simple map to the existing website with Google Map APIs.

```
   <script
src="https://maps.googleapis.com/maps/api/js?v=3.exp&sensor=false"></script>
   <script>
var map;
function initialize() {
  var mapOptions = {
    zoom: 8,
    center: new google.maps.LatLng(latitude, longitude),
    mapTypeId: google.maps.MapTypeId.ROADMAP
  };
  map = new google.maps.Map(document.getElementById('map-canvas'),
      mapOptions);
}

google.maps.event.addDomListener(window, 'load', initialize);

   </script>
```

Through this code, the location that has specified *“latitude”* and *“longitude”* values and map with specified scale will be added to web page.

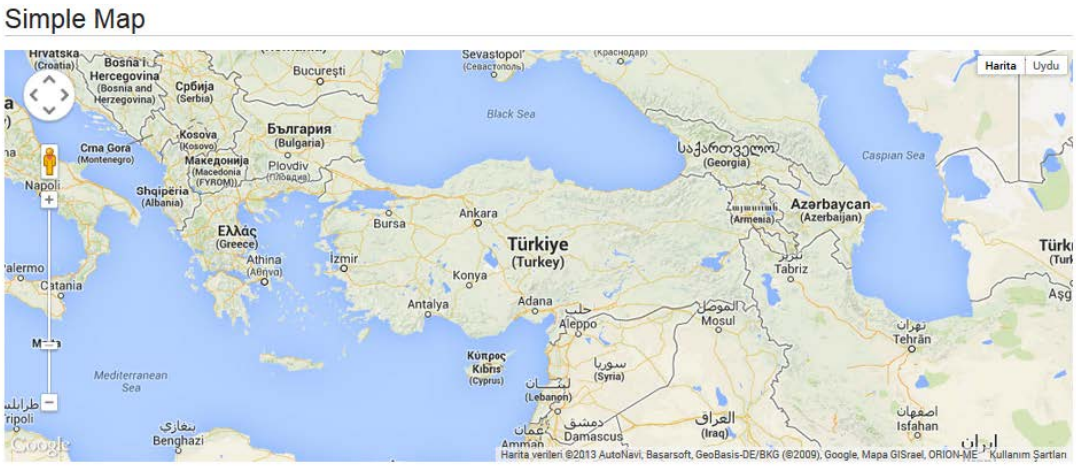


Figure 3.5 Simple Map

Different properties and events can be added to maps added to the Web page. When we include the following JavaScript code which was prepared, a marker is added as shown to the specified location in the figure 3.6. When it clicks on the marker, it zooms in the extent specified on the map.

```
  var marker = new google.maps.Marker({
    position: map.getCenter(),
    map: map,
    title: 'Click to zoom'
  });
  google.maps.event.addListener(map, 'center_changed', function() {
window.setTimeout(function() {
      map.panTo(marker.getPosition());
    }, 3000);
  });
  google.maps.event.addListener(marker, 'click', function() {
    map.setZoom(8);
    map.setCenter(marker.getPosition());
  });
}
```

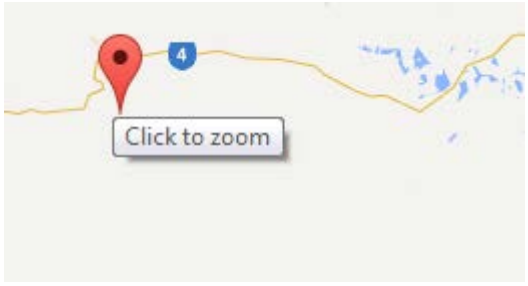


Figure 3.6 Simple Click Events

Many properties and events can be added to the maps by using Google Map APIs. To reduce or enlarge the scale of the map and to scroll around the map, available tools can be added. Markers can be added to specified positions in different ways. When it clicks with the mouse on the map, the specified actions (like adding a label, getting coordinates etc.) can be achieved by adding an event. One or more than one location on the map can be achieved by specifying with pointers. Road routes can be shown on the map by creating the different lines. Circles with specific location and sizes can be created on the map. With helping the parameters offered by Google Map APIs, maps including different functionalities can be created and they can be added to web pages.

3.3 JavaScript

It's useful to start with an idea of the language's history. JavaScript was created in 1995 by Brendan Eich, an engineer at Netscape, and first released with Netscape 2 early in 1996. It was originally going to be called LiveScript, but was renamed in an ill-fated marketing decision to try to capitalize on the popularity of Sun Microsystem's Java language — despite the two having very little in common. This has been a source of confusion ever since.

Microsoft released a mostly-compatible version of the language called JScript with IE 3 several months later. Netscape submitted the language to Ecma International, a European standards organization, which resulted in the first edition of the ECMAScript standard in 1997. The standard received a significant update as ECMAScript edition 3 in 1999, and has stayed pretty much stable ever since. The fourth edition was abandoned, due to political differences concerning language

complexity. Many parts of the fourth edition formed a basis of the new ECMAScript edition 5, published in December of 2009.

This stability is great news for developers, as it's given the various implementations plenty of time to catch up. I'm going to focus almost exclusively on the edition 3 dialect. For familiarity, I will stick with the term JavaScript throughout. Unlike most programming languages, the JavaScript language has no concept of input or output. It is designed to run as a scripting language in a host environment, and it is up to the host environment to provide mechanisms for communicating with the outside world. The most common host environment is the browser, but JavaScript interpreters can also be found in Adobe Acrobat, Photoshop, Yahoo!'s Widget engine, and even server side environments.

JavaScript is an object oriented dynamic language; it has types and operators, core objects, and methods. Its syntax comes from the Java and C languages, so many structures from those languages apply to JavaScript as well. One of the key differences is that JavaScript does not have classes; instead, the class functionality is accomplished by object prototypes. The other main difference is that functions are objects, giving functions the capacity to hold executable code and be passed around like any other object.

3.4 HTML And New Generation HTML5

When you look at a web page in a web browser, you see, at the simplest level, words. These words usually have some style characteristics, such as different font sizes and colors. In many cases a page also displays images or maybe video. Sometimes there is a form where you can enter (or search) for information, or customize the display of the page to your liking. Often a page contains animated content and content that changes while the rest of the page remains the same.

Several technologies (such as CSS, JavaScript, Flash, AJAX, JSON) can be used to define the elements of a web page. However, at the very lowest level, a web page

is defined using HTML (HyperText Markup Language). Without HTML, there is no web page.

In the late 1980s, Tim Berners-Lee was working as a physicist at CERN (the European Organization for Nuclear Research). He devised a way for scientists to share documents over the internet. Prior to his invention, communication via the internet was limited to plain text, using technologies such as email, FTP (File Transfer Protocol), and Usenet-based discussion boards. The invention of HTML made use of a model of content stored on a central server that could be transferred and displayed on a local workstation via a browser. It simplified access to content and enabled the display of "rich" content (such as sophisticated text formatting and the display of images).

HTML is a markup language. It tells the web browser how to display content. HTML separates "content" (words, images, audio, video, and so on) from "presentation" (the definition of the type of content and the instructions for how that type of content should be displayed). HTML uses a pre-defined set of elements to identify content types. Elements contain one or more "tags" that contain or express content. Tags are surrounded by angle brackets, and the "closing" tag (the one that indicates the end of the content) is prefixed by a forward slash.

HTML5 is the complete reformulation of HTML with new capabilities. Still, HTML5 is designed to be backward-compatible with older browsers. Moreover, HTML5 uses an HTML syntax that is compatible with both HTML and XHTML documents. However, processing instructions are not supported. Beyond the well-known text/html media type, a new media type called text/html-sandboxed can also be used, which makes it possible to interpret a file without giving the content access to the rest of the web site. Because of a new approach that separates authoring and rendering conformance requirements, deprecated tags are not needed anymore. HTML5 focuses strongly not only on structural and multimedia elements in the markup but also on application programming interfaces (APIs); thus, web developers with some programming knowledge can develop applications for their web sites.

HTML5 applications are accessible and device-independent, and codes can be reused easily. Additionally, these web applications need declarative programming (and thus much less coding) compared to traditional procedural programming [6]. However, a large share of HTML5 functionalities can be achieved through the use of additional technologies, including CSS3, server-side scripts, JavaScript transformations, Java, or XSLT **(**Sikos, 2013).

3.5 Object-Oriented Programming

Object-oriented programming (OOP) is a programming language model organized around "objects" rather than "actions" and data rather than logic. Historically, a program has been viewed as a logical procedure that takes input data, processes it, and produces output data.

The programming challenge was seen as how to write the logic, not how to define the data. Object-oriented programming takes the view that what we really care about are the objects we want to manipulate rather than the logic required to manipulate them. Examples of objects range from human beings (described by name, address, and so forth) to buildings and floors (whose properties can be described and managed) down to the little widgets on your computer desktop (such as buttons and scroll bars).

The first step in OOP is to identify all the objects you want to manipulate and how they relate to each other, an exercise often known as data modeling. Once you've identified an object, you generalize it as a class of objects (think of Plato's concept of the "ideal" chair that stands for all chairs) and define the kind of data it contains and any logic sequences that can manipulate it. Each distinct logic sequence is known as a method. A real instance of a class is called (no surprise here) an "object" or, in some environments, an "instance of a class." The object or class instance is what you run in the computer. Its methods provide computer instructions and the class object characteristics provide relevant data. You communicate with objects - and they communicate with each other - with well-defined interfaces called messages.

The concepts and rules used in object-oriented programming provide these important benefits:

- The concept of a data class makes it possible to define subclasses of data objects that share some or all of the main class characteristics. Called inheritance, this property of OOP forces a more thorough data analysis, reduces development time, and ensures more accurate coding.
- Since a class defines only the data it needs to be concerned with, when an instance of that class (an object) is run, the code will not be able to accidentally access other program data. This characteristic of data hiding provides greater system security and avoids unintended data corruption.
- The definition of a class is reuseable not only by the program for which it is initially created but also by other object-oriented programs (and, for this reason, can be more easily distributed for use in networks).
- The concept of data classes allows a programmer to create any new data type that is not already defined in the language itself.

Simula was the first object-oriented programming language. Java, Python, C++, Visual Basic .NET and Ruby are the most popular OOP languages today. The Java programming language is designed especially for use in distributed applications on corporate networks and the Internet. Ruby is used in many Web applications. Curl, Smalltalk, Delphi and Eiffel are also examples of object-oriented programming languages. Delphi is used in this thesis applications.

3.6 Relational Database And Database Management System

A database is a means of storing information in such a way that information can be retrieved from it. In simplest terms, a relational database is one that presents information in tables with rows and columns. A table is referred to as a relation in the sense that it is a collection of objects of the same type (rows). Data in a table can be related according to common keys or concepts, and the ability to retrieve related data from a table is the basis for the term relational database. A Database Management System (DBMS) handles the way data is stored, maintained, and retrieved. In the

case of a relational database, a Relational Database Management System (RDBMS) performs these tasks.

Relational tables follow certain integrity rules to ensure that the data they contain stay accurate and are always accessible. First, the rows in a relational table should all be distinct. If there are duplicate rows, there can be problems resolving which of two possible selections is the correct one. For most DBMSs, the user can specify that duplicate rows are not allowed, and if that is done, the DBMS will prevent the addition of any rows that duplicate an existing row.

A second integrity rule of the traditional relational model is that column values must not be repeating groups or arrays. A third aspect of data integrity involves the concept of a null value. A database takes care of situations where data may not be available by using a null value to indicate that a value is missing. It does not equate to a blank or zero. A blank is considered equal to another blank, a zero is equal to another zero, but two null values are not considered equal.

SQL (Structured Query Language) is a language designed to be used with relational databases. There is a set of basic SQL commands that is considered standard and is used by all RDBMSs. For example, all RDBMSs use the SELECT statement. A SELECT statement, also called a query, is used to get information from a table. It specifies one or more column headings, one or more tables from which to select, and some criteria for selection. The RDBMS returns rows of the column entries that satisfy the stated requirements. The WHERE clause in a SELECT statement provides the criteria for selecting values. A distinguishing feature of relational databases is that it is possible to get data from more than one table in what is called a join.

SQL commands are divided into categories, the two main ones being Data Manipulation Language (DML) commands and Data Definition Language (DDL) commands. DML commands deal with data, either retrieving it or modifying it to

keep it up-to-date. DDL commands create or change tables and other database objects such as views and indexes.

The rows that satisfy the conditions of a query are called the result set. The number of rows returned in a result set can be zero, one, or many. A user can access the data in a result set one row at a time, and a cursor provides the means to do that. A cursor can be thought of as a pointer into a file that contains the rows of the result set, and that pointer has the ability to keep track of which row is currently being accessed. A cursor allows a user to process each row of a result set from top to bottom and consequently may be used for iterative processing. Most DBMSs create a cursor automatically when a result set is generated.

When one user is accessing data in a database, another user may be accessing the same data at the same time. If, for instance, the first user is updating some columns in a table at the same time the second user is selecting columns from that same table, it is possible for the second user to get partly old data and partly updated data. For this reason, DBMSs use transactions to maintain data in a consistent state (data consistency) while allowing more than one user to access a database at the same time (data concurrency).

A transaction is a set of one or more SQL statements that make up a logical unit of work. A transaction ends with either a commit or a rollback, depending on whether there are any problems with data consistency or data concurrency. The commit statement makes permanent the changes resulting from the SQL statements in the transaction, and the rollback statement undoes all changes resulting from the SQL statements in the transaction.

A lock is a mechanism that prohibits two transactions from manipulating the same data at the same time. For example, a table lock prevents a table from being dropped if there is an uncommitted transaction on that table. In some DBMSs, a table lock also locks all of the rows in a table. A row lock prevents two transactions from

modifying the same row, or it prevents one transaction from selecting a row while another transaction is still modifying it.

A stored procedure is a group of SQL statements that can be called by name. In other words, it is executable code, a mini-program, that performs a particular task that can be invoked the same way one can call a function or method. Traditionally, stored procedures have been written in a DBMS-specific programming language. The latest generation of database products allows stored procedures to be written using the Java programming language and the JDBC API. Stored procedures written in the Java programming language are bytecode portable between DBMSs. Once a stored procedure is written, it can be used and reused because a DBMS that supports stored procedures will, as its name implies, store it in the database.

Databases store user data, and they also store information about the database itself. Most DBMSs have a set of system tables, which list tables in the database, column names in each table, primary keys, foreign keys, stored procedures, and so forth. Each DBMS has its own functions for getting information about table layouts and database features. JDBC provides the interface DatabaseMetaData, which a driver writer must implement so that its methods return information about the driver and/or DBMS for which the driver is written. For example, a large number of methods return whether or not the driver supports a particular functionality. This interface gives users and tools a standardized way to get metadata. In general, developers writing tools and drivers are the ones most likely to be concerned with metadata.

IBM DB2, InterBase, Microsoft Access, Microsoft SQL Server, MySQL, PostgreSQL, SQLBase and Oracle are examples of Relational Databases. A lot of big companies, public corporations and universities uses oracle database. Oracle is the most popular, secure, flexible database. Dokuz Eylül University is uses Oracle Database and therefore, oracle is used while developping the application.

CHAPTER FOUR
CASE STUDY

If GIS only makes an analysis with obtained data in accordance with certain purposes and results are used for part of the solution of the problem, GIS is used as a tool. If GIS is utilized from all other features by containing the design phase for any problem, it is used as a system. GIS has become to use synonymously with the spatial information systems by improving application field and analysis capabilities each passing day (Tecim, 2008).

GIS-based computer software has been developed to assign, monitor, control and report for using the vehicles within Dokuz Eylül University selected as a workspace. It has been looked for a solution to the existing problems by creating a GIS-based system because of the fact that the authorized person cannot be followed during the use of vehicles within the institution, cannot be reported during use and after, and also due to the lack of the necessary data for monitoring.

GPS module, which is in order to obtain the location data of the public vehicles; Oracle Database, which is a data storage channel; Delphi computer programming language, which is an application development tool; Google Map APIs, which is in order to obtain digital map data in the program; JavaScript and HTML5 programming languages in the Delphi programming language, which is in order to use the data obtained in the program is used on GIS-based application. Created GIS-based system carried out in three stages.

- The vehicle location data acquisition with GPS
- The creation of the database structure
- Development of Vehicle Tracking Application Software

4.1 The Vehicle Location Data Acquisition With GPS

GPS Tracker Unit must be connected to vehicles to obtain the location data via GPS. The general structure of a GPS Tracker Unit is shown in Figure 4.1. SIM (Subscriber Identity Module) card obtained from a GSM (Global System for Mobile Communication) company is added into GPS Tracker Unit. The necessary settings must be made in order to send the data obtained by the GPS receiver that is in GPS Tracker Unit to the system has specified IP address as often as required. These settings are provided with a set of code by manufacturer of GPS Tracker. These settings can be done by sending an SMS to SIM card number mounted on GPS Tracker.

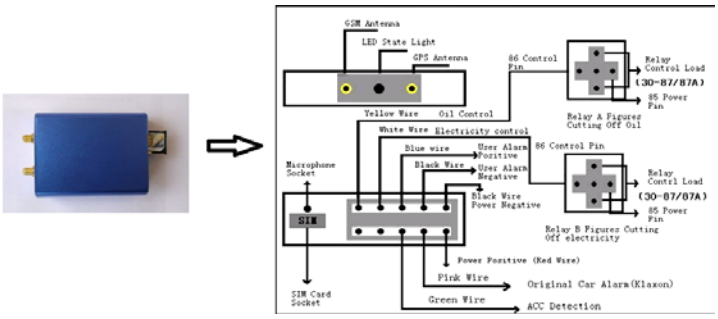


Figure 4.1 Gps Tracker unit

The data obtained from the GPS receiver is sent to system that has a predetermined IP (Internet Protocol) address through GPRS (General Package Radio Service) or SMS (Short Message Service) with a SIM card in the GPS Tracker Unit.

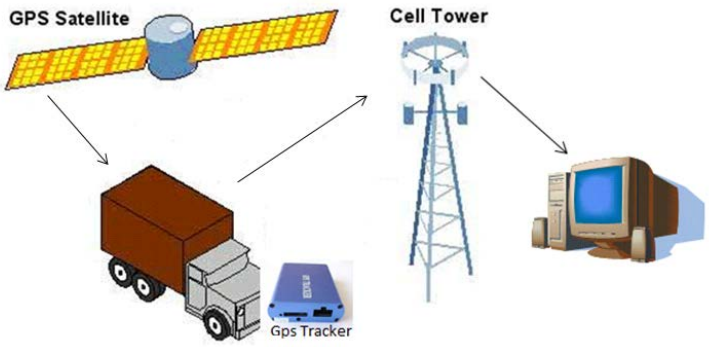


Figure 4.2 Transmission of location data

GPS Tracker transmits the data taken from GPS to the specified IP address. The received data from the web-based computer software in transmitted address is converted to desired data type by analyzing. Data specified by the manufacturer can be transferred to the desired system after resolve and convert to desired type. Oracle Database is used as data storage space in the public vehicle tracking application prepared by us. Therefore, transferring the location data obtained by GPS Tracker Unit mounted to vehicles into table prepared on Oracle Database with web-based software can be achieved with this software.

4.2 The Creation of the Database Structure

Oracle Database 10g was used on applications developed within Dokuz Eylul University identified as a workspace. Oracle XE 10g has been used in terms of compatibility while the public vehicle tracking system application was developing. In this way, application integration in the existing system and data sharing can be achieved. A new installation of Oracle Database can be made in order to use application within the organization so that the data exchange can be provided as establishing Database Link between the existing database system and new created Oracle Database. A new Database User can be defined in the existing database for the public vehicle tracking application. Thus, owing to "Database Users" created for the other projects in the system, data exchange can be done with the required authorizations.

It is aimed to establish a relationship between the existing data and the location data obtained via GPS Tracker Unit while the database structure is creating. The location data is accessible to the existing and new created data with this structure is created. Likewise, it can be provided to reach from the location data to the existing and created on application data. The required interrogation procedures between associated fields among tables created by using SQL can be created in the structure of Oracle, which is related database on. As a result of the query, the required data through the tables being queried can be obtained.

4.2.1 Database Tables

Database tables created and their relationship are as shown in Figure 4.3. Using the location data fields specified in the schema. As can be seen in the tabulation, "Latitude (Lat)" and "Longitude (Lng)" as GPS-coordinate are used in definitions of data that contains the address data such as the place to go with the tasking order, institution, faculty and parking. This data needs to be defined by the relevant officer. To identify this data, the use of digital maps in application and using the digital maps as data generation tool as well as reporting tool are planned.

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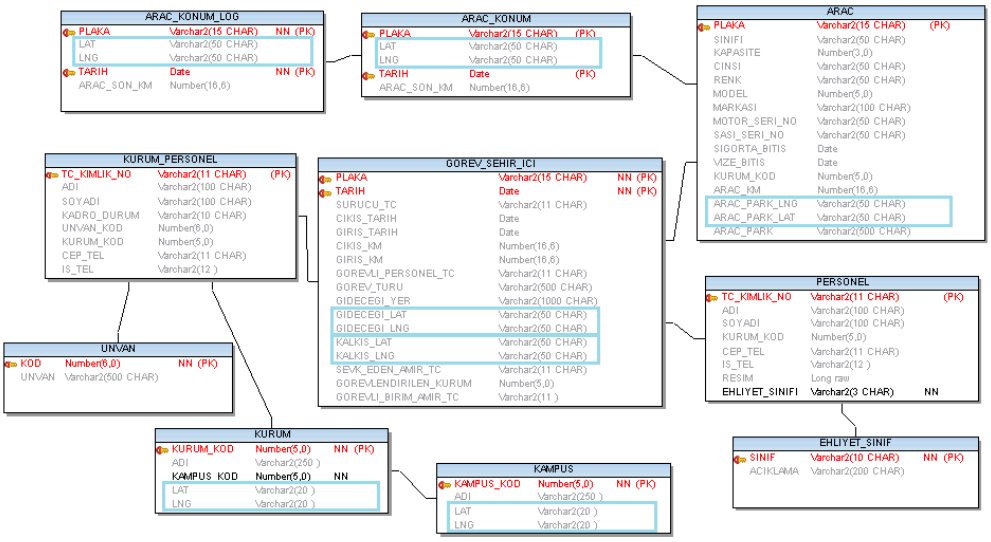


Figure 4.3 Database tables relationships

The lists prepared by related officer and tasking order template used within Dokuz Eylul University are considered while tables and table fields on database are taken into consideration. The database in conformity with reporting location-based and non-location-based data is attempted to establish. Data on the existing database system such as personal that public vehicles are offered to and officers that use the vehicles information, stated within Dokuz Eylul University. Table structure is considered while "tables" is creating. Hence, being synchronized with an important data easily is aimed.

4.2.2 Database Triggers

Oracle allows you to define procedures that are implicitly executed when an INSERT, UPDATE, or DELETE statement is issued against the associated table. These procedures are called database triggers.

It is aimed to access to the location data provided by the GPS Tracker while designing the database structure. For this purpose, the last location data of vehicles are saved in "ARAC_KONUM" table stored the location of vehicles. In this table, it has been only the data as the existing vehicles number. Previous data from the last location data of vehicle are stored in "ARAC_KONUM_LOG" table. Thus, the last location data of a vehicle can be queried in "ARAC_KONUM" table that contains a small amount of data quickly. The location data used in the past with the purpose of reporting can be queried with the data obtained from "ARAC_KONUM_LOG" table.

To create this structure, Database Trigger has been created for "ARAC_KONUM" table. The last location data is added into "ARAC_TABLE_LOG" table structure before "INSERT" and "UPDATE" events happens into "ARAC_KONUM" with this Trigger. "INSERT" occurs once for a vehicle into "ARAC_KONUM" table. After initial recognition, "UPDATE" event realizes in "ARAC_KONUM" table for all of the data provided by GPS Tracker. Hence, the one data includes information of the one vehicle in "ARAC_KONUM" table. "INSERT" event always occurs through Trigger created in "ARAC_KONUM_LOG" table. The location data is stored with the date in "ARAC_KONUM_LOG" table to provide a location & time relationship for a vehicle.

Database trigger written for "ARAC_KONUM" table is given below.

```
BEGIN
  tmpVar := 0;
ESKI_LAT :=to_number(replace(:OLD.LAT,',','.'));
ESKI_LNG :=to_number(replace(:OLD.LNG,',','.'));
YENI_LAT :=to_number(replace(:NEW.LAT,',','.'));
```

```
    YENI_LNG :=to_number(replace(:NEW.LNG,',','.'));
    tmpVar:=deu.mesafe(ESKI_LAT,ESKI_LNG,YENI_LAT,YENI_LNG);
    IF tmpVar <> 0 then

        :NEW.ARAC_SON_KM:=tmpVar;
        UPDATE ARAC A SET A.ARAC_KM=A.ARAC_KM+tmpVar WHERE
PLAKA=:NEW.PLAKA;

        Insert into DEU.ARAC_KONUM_LOG
       (PLAKA, LAT, LNG, TARIH, ARAC_SON_KM)
        Values
       (:NEW.PLAKA, :NEW.LAT, :NEW.LNG, SYSDATE,
:NEW.ARAC_SON_KM);
    end if;

      EXCEPTION
        WHEN OTHERS THEN
          -- Consider logging the error and then re-raise
          RAISE;
    END ARAC_KONUM_UPDATE;
    /
```

4.2.3 Database Functions

Creating user's own "database functions" allows in Oracle. Database functions can be invited by triggers, functions, procedures and prepared software created in the database. Database functions in Oracle operating with parameters and returning a result parameter and written with PL/SQL query language is a script.

"ARAC_KM" field exists in "ARAC" table created. This field represents the distance taken by the vehicle in terms of KM. There is also "ARAC_SON_KM" field in "ARAC_KONUM_LOG" table. This field represents the distance between the

previous location and the last location in terms of KM. A function has been created to generate this information in our database structure.

The generated function is as follows:

```
CREATE OR REPLACE FUNCTION DEU.mesafe (startLat NUMBER , startLng
NUMBER  , endLat NUMBER , endLng NUMBER)
  RETURN NUMBER
IS
  tmpvar   number;
BEGIN
tmpvar:=0;
if  Abs(startLng-endLng) > 0.00001 then
   BEGIN
      SELECT  ACOS(SIN(startLat * 3.14159 / 180) * SIN(endLat * 3.14159 / 180)
+ COS(startLat * 3.14159 / 180) * COS(endLat * 3.14159 / 180) * COS((startLng -
endLng) * 3.14159 / 180)) * 180 / 3.14159 * 60 * 1.1515*1.609344 AS Distance
      into
      tmpvar
      FROM dual;
      EXCEPTION
      WHEN NO_DATA_FOUND
      THEN RETURN -1;
   END;
END IF;
       RETURN round(tmpvar,6);
END;
/
```

This function measures the distance between two coordinates sent as a parameter. As a result, the distance between two locations is returned in terms of KM. This function is invited by created trigger. The distance between the previous location and

the last location can be founded thanks to this function. The data that returns as a result of function is added to "ARAC_SON_KM" field in "ARAC_KONU_LOG" table. The first value of "ARAC_KM" field in "ARAC" table is entered by the relevant officer with the prepared program. By dint of Trigger prepared by us, as collecting the value in "ARAC_KM" field and the data obtained with this function, "ARAC_KM" field is updated. In this way, KM information can be up-to-date.

4.3 Software Devolopment for Vehicle Tracking System

Software has been prepared for tracking, managing and reporting public vehicles. When preparing this software, Delphi programming language which is Object-Oriented programming language has been used. HTML and Java Script programming language have been used in Delphi programming language. Thus, Google APIs offered by Google Company is usable in Delphi programming language. Saving data and reading existing data are provided by contacting with Oracle database in this software.

The prepared software consists of main form, four menu elements on the top of the main form, subforms which ara accessed through menü items and procedures that allow tracking vehicles at the same time. The top menu headings used in software are as follows.

- Definitions
- Vehicle Assignment
- Report
- View

4.3.1 Tracking the Position of Vehicles of the Institution at The Same Time

The location data obtained from GPS is organized and it is transferred to tables prepared on Oracle database by GPS Tracker. Data transferred into tables is organized with database trigger prepared on Oracle database. Main form can be

monitored for tracking the position of vehicles simultaneously by using generated database structure associated with the location data.

Main form opens with the start of the software. There is a “Web Browser” component attached to main form. When main form opens the code sequence in the “Form Activate” event runs. It is ensured to run in Delphi by creating HTML and JavaScript code sequences on “Form Activate” event. A web page is created with HTML and it is transferred into web browser in main form. It is established to communicate online with Google Map APIs owing to JavaScript Functions used in HTML code sequence. Hence, displaying the digital maps offered by Google Company on Web Browser in the main form and realizing the desired events on the maps are provided. Google Maps and Google APIs can run as parts of prepared program because Web Page on Web Browser has been created in this program. All digital maps used in this software are created with this structure.

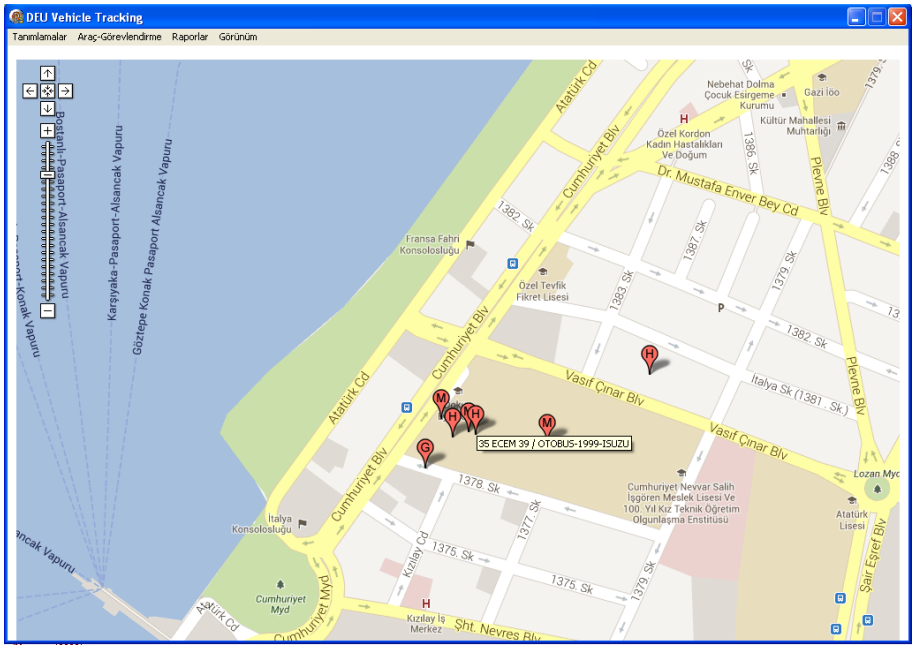


Figure 4.4 Screen view MainForm of vehicle tracking program

When MainForm runs, it connects to the Oracle Database. "Arac_Konum" table which contains the last location data of the vehicles is queried. The location data of the vehicles are marker on the Google Map in the Web Browser. This process is repeated automatically at specific time periods and updated data is displayed on map.

Each marker represents vehicles and the location of vehicles. Specific markers with letters are used. These letters are "M", "H" and "G". "M" represents official vehicles. "H" represents service vehicles. "G" also represents a service vehicle commissioned formally. When mouse locates on marker, information of the plate, type, model and brand is displayed on the map as a comment. Hence, in addition to the location, a lot of information can be displayed on the map at the same time. When you click on marker, a Delphi form runs and vehicle information is displayed in this form. If this vehicle is commissioned, commissioning information is also shown with vehicle information in the form popping-up. Thanks to menu elements under "Görünüm" the top menu on MainForm, Grid List provided to reach the existing vehicle location quickly can be added.

4.3.2 Definitions

Some of the data should be defined in software by the relevant civil servant in order to use software. This data can be done from the menu stated under the heading of top menu which is "definitions". The entry of existing data within the institution is done here in the software. Information entries for the use of vehicles are the data used the assignment, reporting and operating.

4.3.2.1 Campus Information

Dokuz Eylül University has a disorganized state. There are campuses in different regions in the province of Izmir. This is the case for many other institutions like that. On the digital maps used on software, campus information is defined for the purpose of positioning on campuses quickly. The name of campus and its location data is entered as using the prepared form. The user can add a new campus. With helping of Grid List, the user can reach the information of campus which data entry was done before. If there is no unit defined in the campus, campus information can be deleted.

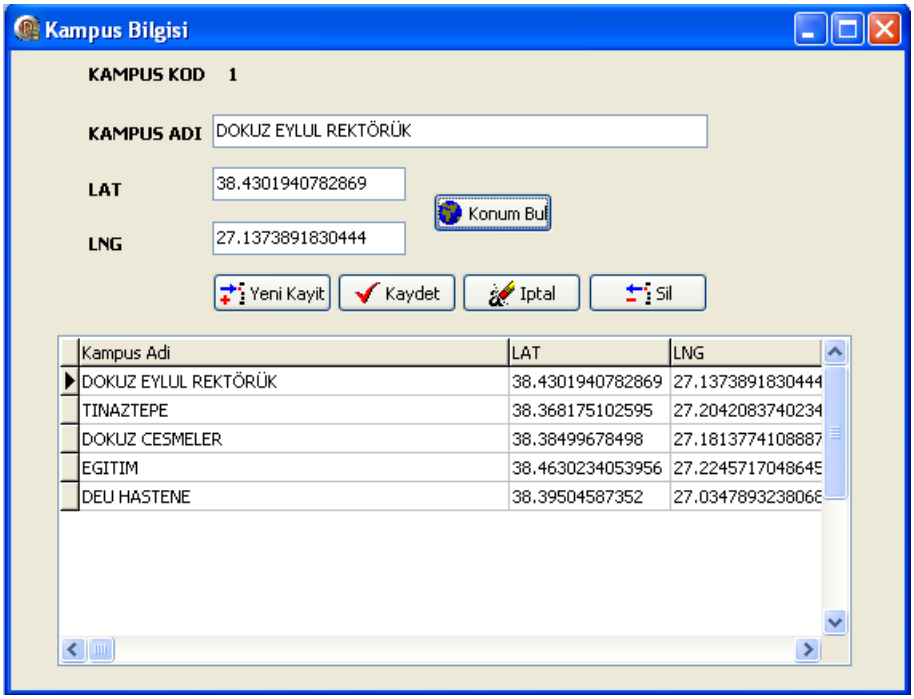


Figure 4.5 Screen view WindowsForm that campus information is defined

The location data of the campus is indicated by selecting on Google Maps presented in window popping-up by clicking on the "Konum Bul" button. The desired location on the map is reachable by searching on the information as defined on the map or with helping the mouse. Map scale can be adjusted by the user. Marker is added to the clicked location when clicking the selected location on the map. Longitude and latitude data for the selected location is shown on the form. Longitude and Latitude values of the location data marked by clicking "Konum Seç" button are transferred to the fields on Campus Information Form contained in. If the campus location data has been selected before, the predetermined location data is located and marked with marker on the map by clicking "Konum Bul" button.

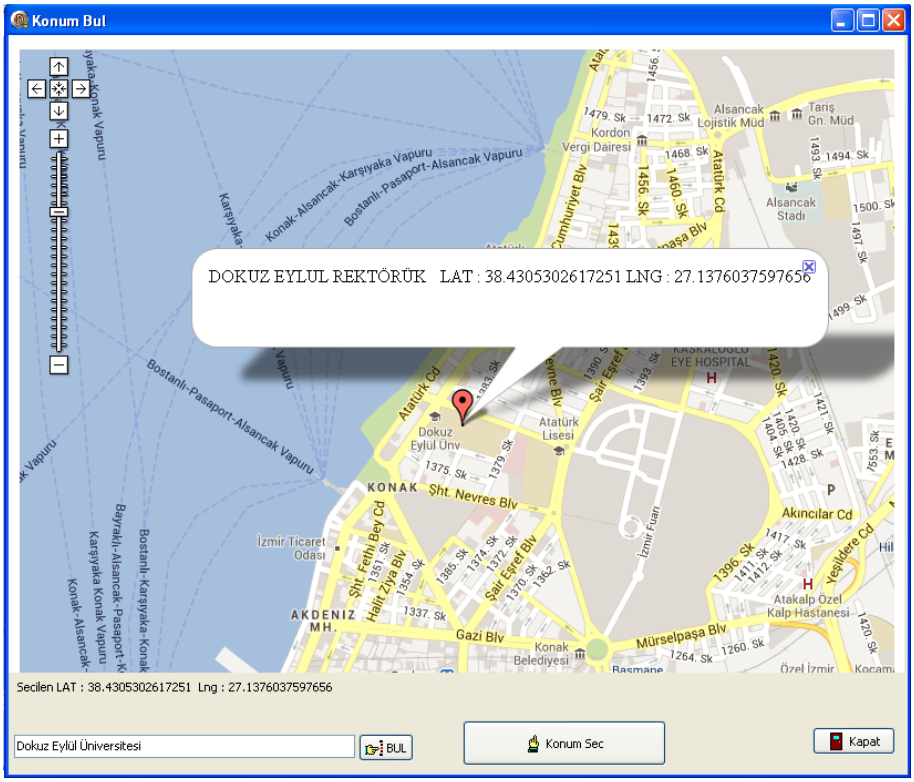


Figure 4.6 Screen view WindowsForm which the campus location selected on the map

4.3.2.2 Institution Information

Dokuz Eylül University is the section in which administrative and academic institutions are defined. The name of institution inputted the data, which campus is in and the location data of institution are inserted from prepared form. Here, the user can add a new unit. User can reach the information of the unit which data entry was done before by selecting them with the help of Grid List. User can also delete the institution information which has already entered.

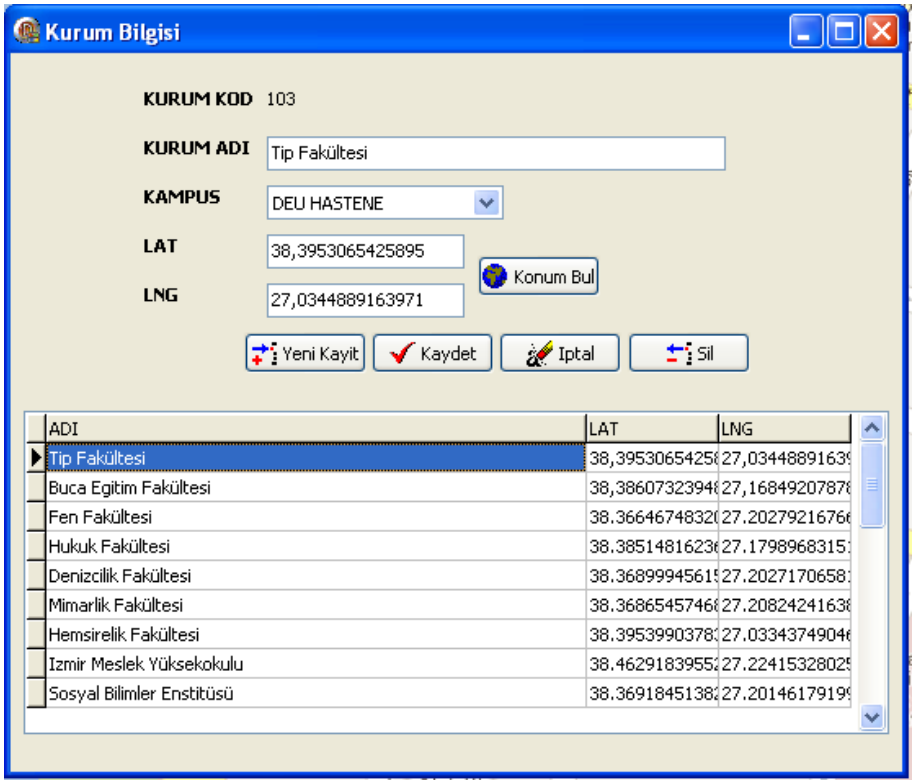


Figure 4.7 Screen View WindowsForm that institution information is entered

Institutions are located under the campus which the entry of data is done before in. The unit location data can be determined by marking on the digital map in form opened with helping button "Konum Bul" in window inputted data. The list of campuses that has been described is listed with the Grid List on the form opened. The campus which the user unit is in can be located rapidly by selecting here. The selected location is marked with a marker. Coordinates of the selected location is shown on the form and the digital map. The data of the selected location is transferred to the related fields on the form of institution information by clicking “Konum Seç” button. If there is a pre-defined location data, the digital map is located to this location when clicking "Konum Bul" button and the selected location is marked with a marker.

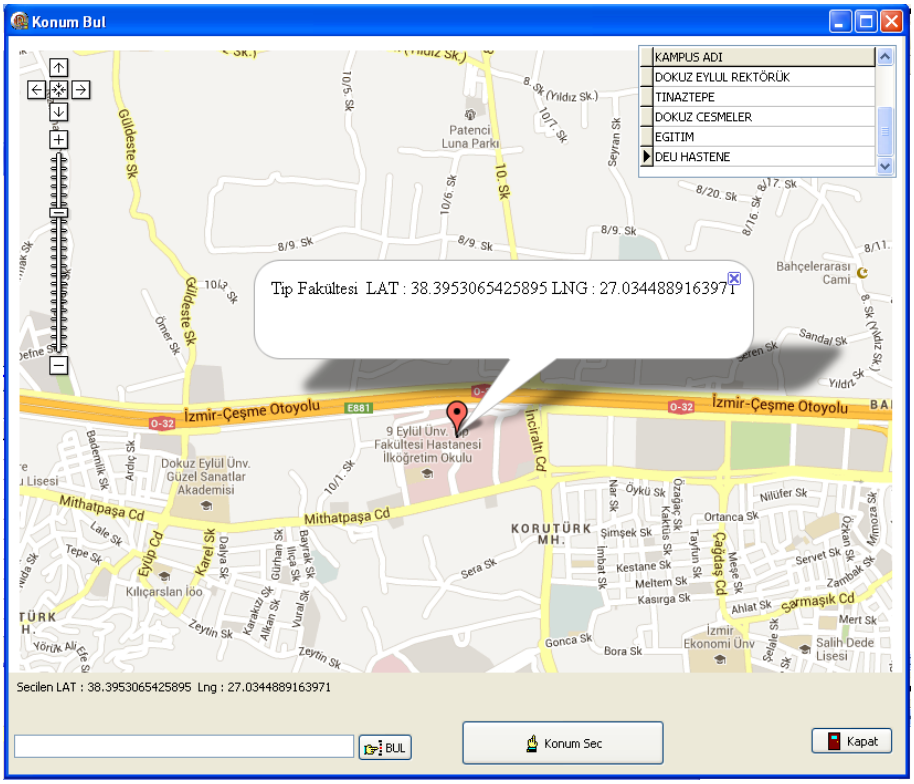


Figure 4.8 Screen view WindowsForm that the position of institution selected on the map

4.3.2.3 Driver Information

Staff authorized to use the vehicles within the institution are defined in this section. In public institutions, the staff defined as a driver uses the public vehicles. The window that driver information defined is shown in Figure 4.9. The credentials of drivers, information of institution that they are attached in, the contact information and class information of driver's license can be added and arranged on this window. Drivers' information of the institution is selected from the ComboBox list created by investigating the data defined on window "Kurum Bilgileri". The desired staff information can be reached from Grid List and the existing data can be learnt. This information is in the structure of the staff automation project developed within Dokuz Eylül University. The required data can be inserted into the system by taking from here. The data that is not in the existing system such as the class of license can be arranged with the help of this software.



Figure 4.9 Screen view of WindowsForm entered the driver information

Driver's photos can be added in the structure of program. This data can be provided in the existing structure of institution and also as shown in Figure 4.10, it can be added by the user.

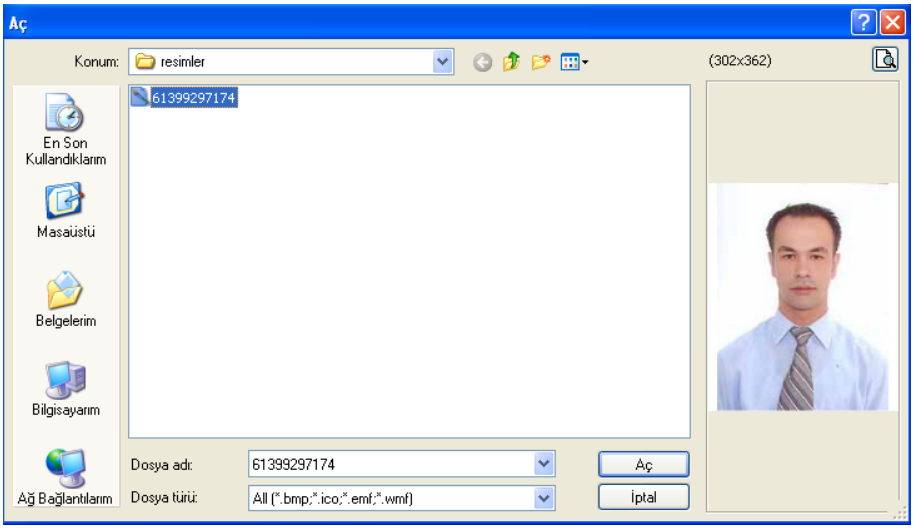


Figure 4.10 Screen view of WindowsForm adding driver photo to driver

4.3.2.4 Staff Information

Institution vehicles are used for serving to its staff. Information of staff served the vehicles is defined in this section. All staff in the institution's data entries is prepared though this form and there is a staff list entered the information in Grid List added onto Form. It can be reached data entry of the selected staff by using Grid List. New entry can be added, the existing data can be edited and the staff entered the information can be deleted on prepared Form for staff information, as shown in Figure 4.11. The number of staff can be quite a lot in large institutions such as Dokuz Eylül University. Thanks to prepared database structure, staff information can be easily reached from the existing system in the institution.

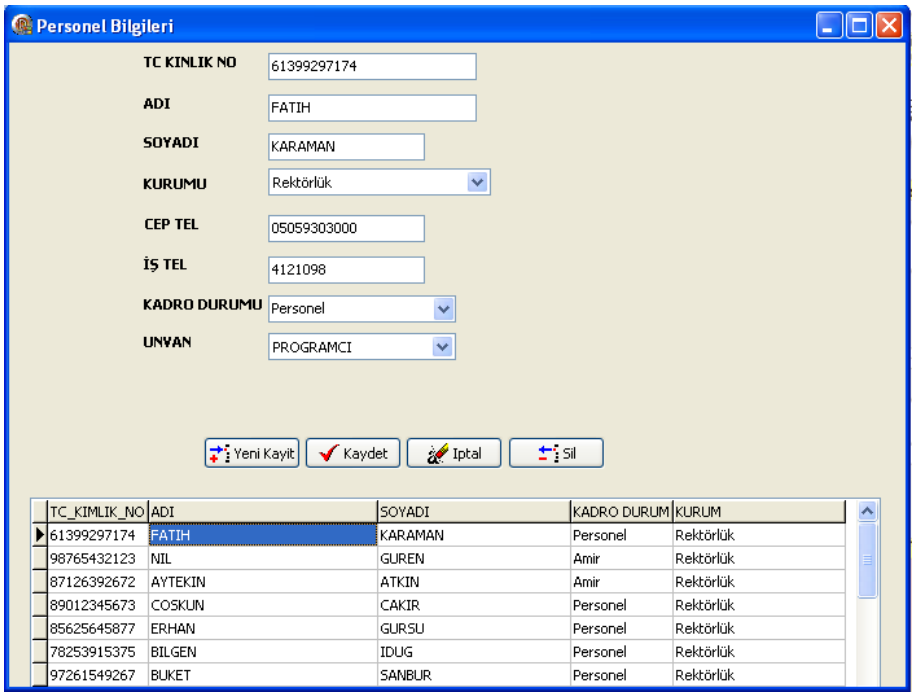


Figure 4.11 Screen view of WindowsForm entered the staff information

4.3.2.5 Vehicle Information

Information of vehicles within the institution is described in this section. Information of license plate, physical appearance, brand, engine and chassis is entered by user with prepared form. The form consists of data fields in accordance with reports prepared by institution and requirements. "Kurumu" field specifying the

vehicle which institution belongs to is selected as querying data defined on "Kurum Bilgileri" Windows Form database generated ComboBox List. Whether the vehicle is for authority or service is defined in this section. Insurance and visa expiry dates of vehicle are updated here periodically. KM data is entered onto Form. KM data enters when the vehicle defines firstly in here. This field is updated automatically with helping "Database Trigger" and "Database Function". It can be updated by user in here when any problem caused by the system occurs.

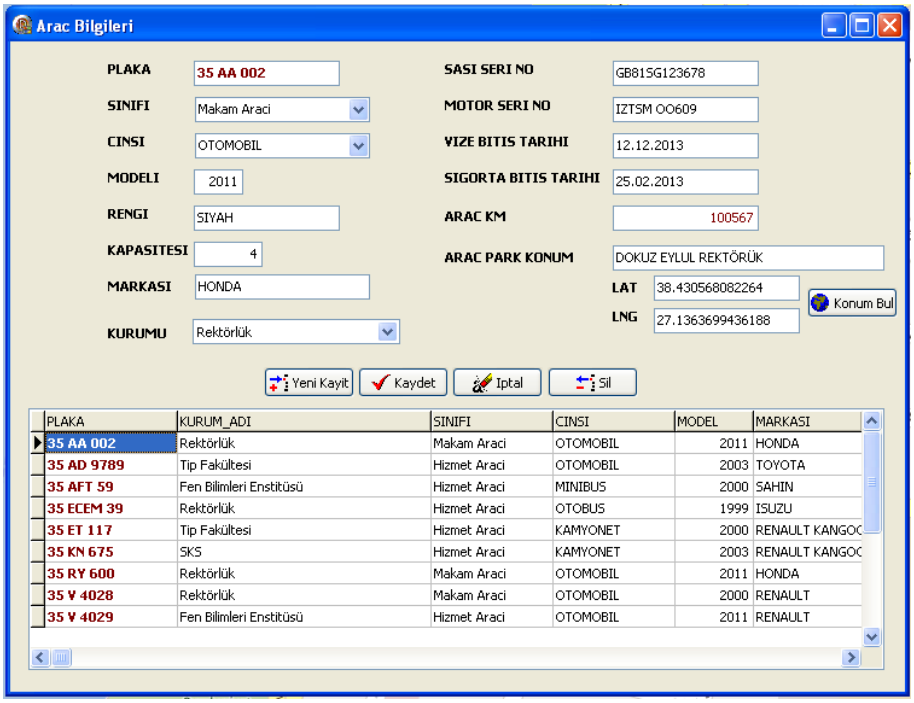


Figure 4.12 Screen view WindowsForm inserting the vehicles information

Public vehicles have to be parked to parking space when tasks finish. As shown in Figure 4.13, the location where the vehicle is parked is transferred as selecting from digital maps on form. The location data transferred from digital maps is stored as "Longitude" and "Latitude". Digital maps are used as an input in here. User determines the location where the vehicle is parked by marking on the map. The values of the location data marked as Longitude and Latitude are shown on the form and map. Grid List containing the lists of units in campus has been added in prepared form as shown in Figure 4.13. The desired location can be located as selecting a unit or a campus from lists in here. The location where vehicle is parked can be named with text defined by user and the data used to search a location. If the data of location

where the vehicle parks is determined by user, the map is positioned itself to the existing location directly and marks with "Marker" when "Konum Bul" button clicks. Thus, user can specify the location where vehicle parks on the map and can see the location determined before and the location data can be updated as selecting a new location.

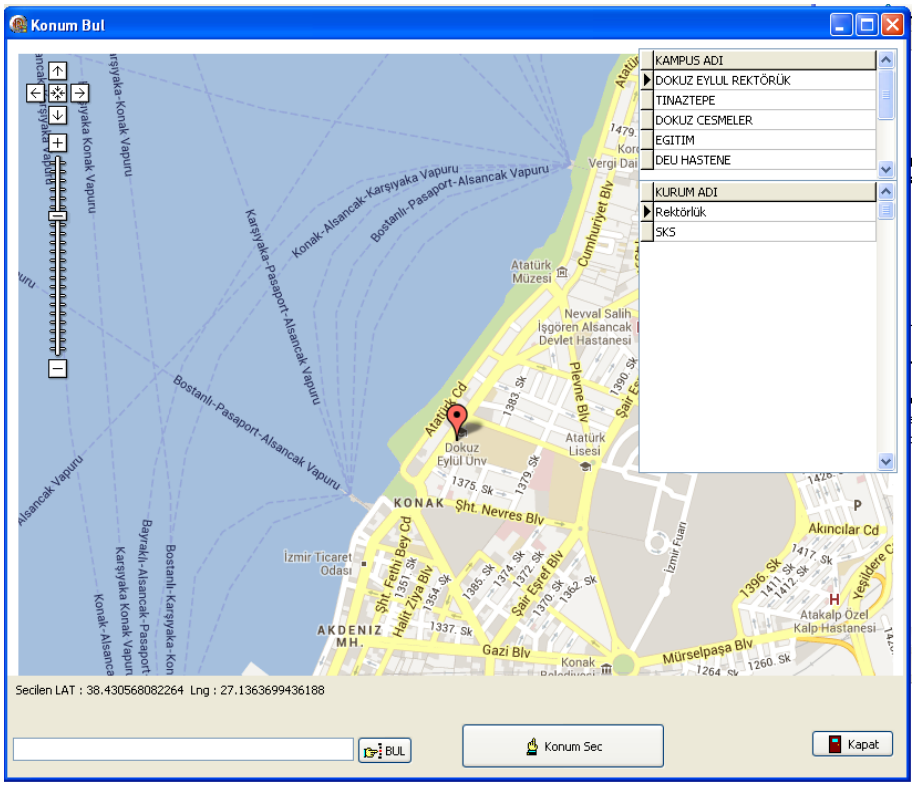


Figure 4.13 Screen view WindowsForm selecting the location that the vehicles are parked on the map

4.3.3 Vehicle Commissioning

Commissioning documents are regulated to use of vehicle within institution on "Araç Bilgileri" window as a means of service in the program. "Yeni Görevlendirme" and "Görevlendirme Bitiş" windows have been prepared as remaining loyal to this form regulated by institution. By dint of menu elements under "Araç Görevlendirme" the top menu, these windows can be accessible. To use the official vehicles, there is no need to commissioning documents.

4.3.3.1 New Commissioning

Commissioning data inputs of service vehicle have to be done before using. Start date and time of commissioning, staff put the vehicle into service and his/her chief, the chief whom the vehicle is commissioned, license plate, driver and where to go location data are inputted on prepared Form on window reached "Yeni Görevlendirme" menu elements. When window pops-up, the system date and time appear automatically and the user can update it. All data on Form is obtained from data defined under "Tanımlar" the top menu. This data is listed on window popping-up with helping the button next to field to enter information.

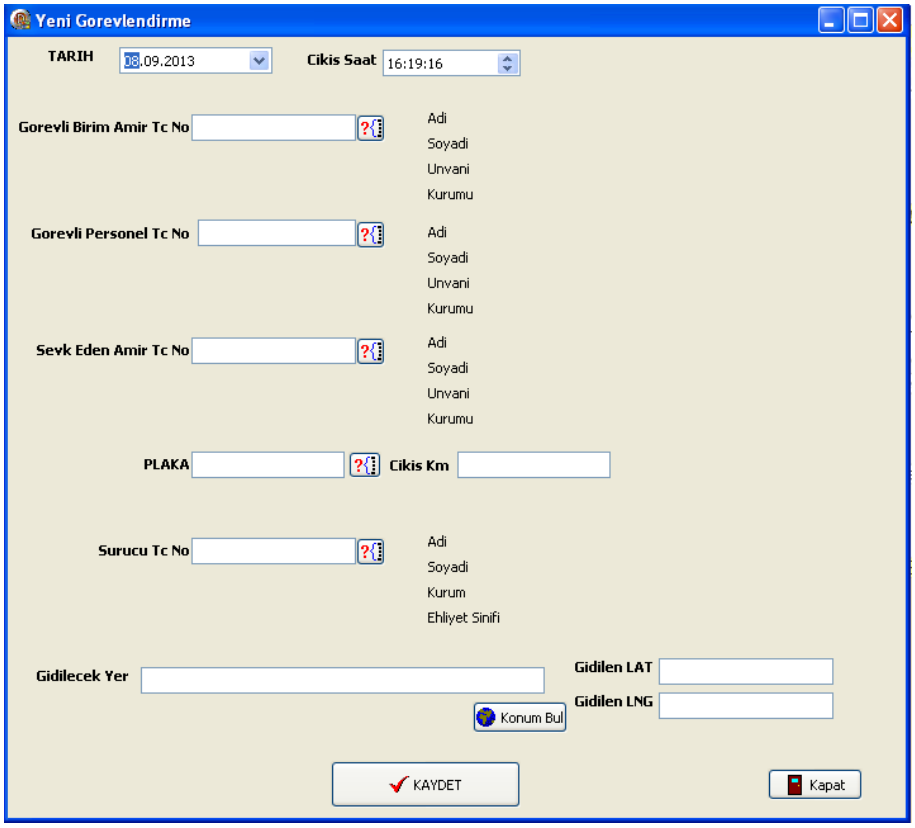


Figure 4.14 Screen view WindowsForm inputted of commissioning information

Information of chief of staff who served in the service of the vehicle and chief that the vehicle is commissioned by has been offered as shown in Figure 4.15. User selects the relevant officer in there. Chief list are obtained by querying data of staff as defined a chief and staff status are obtained from staff data entered on window

"Personel Bilgileri". Data of staff who served in the service is also listed by querying all staff data inserted. Information of driver using the vehicle can be selected from lists obtained from data inserted on window "Sürücü Bilgileri". It can be searched with the name of the staff on the window popping-up. T.C. identifications of staff selected with the button "Kişi Seç" on the form are transferred to the form "Yeni Görevlendirme". The names, surnames, titles and institutions of the selected staff are shown to user for informational purposes only on the form in here.

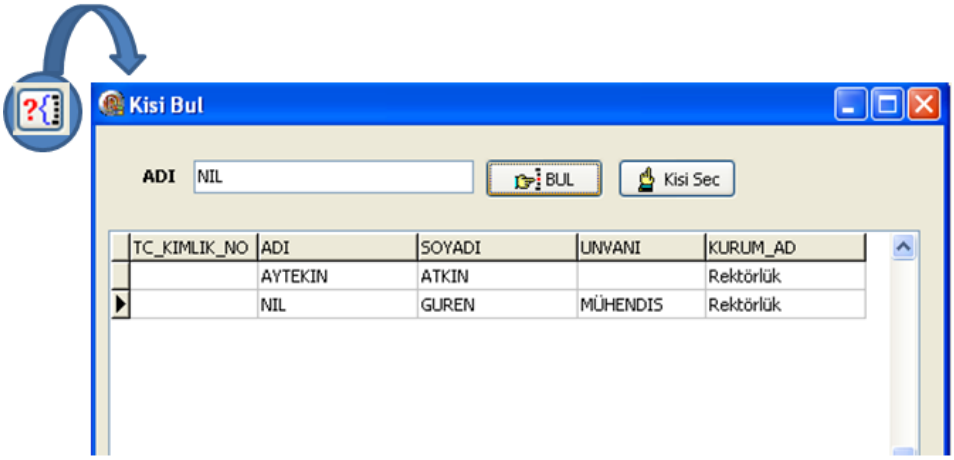


Figure 4.15 Screen view WindowsForm selected institution chiefs from the list

The plate information have to be entered to specify the vehicle used in the commissioning. It can be written to a specific field on the form by user or can be selected from window popping-up with the button "Bul". Window viewed the location data and the vehicle information by user at the same time has been prepared to select a suitable vehicle. The prepared window "Araç Bul" has a structure containing a list of vehicles and the location of vehicles on the digital maps as shown in Figure 4.16. There is some information entered on window "Araç Bilgileri" in Grid List displayed the list of vehicles. Information like the plate, capacity and brand of the vehicle in the list has been added to inform the user. User can select a vehicle with the help of Grid List. The current position of the vehicle is automatically located on the digital map when selecting a vehicle. The locations of the vehicles are marked with Marker on the map. The vehicle selected on map in Grid List is simultaneously located when selecting Marker specifying the vehicles on the digital map. Thus, there

is a relationship between data from the digital map and Grid List on the form in this structure.

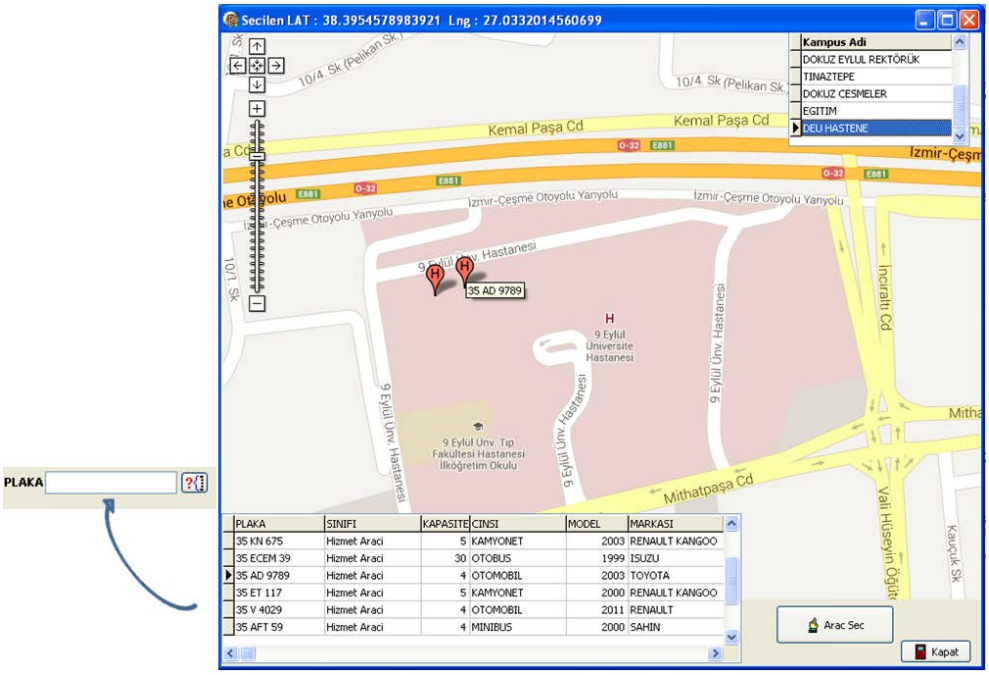
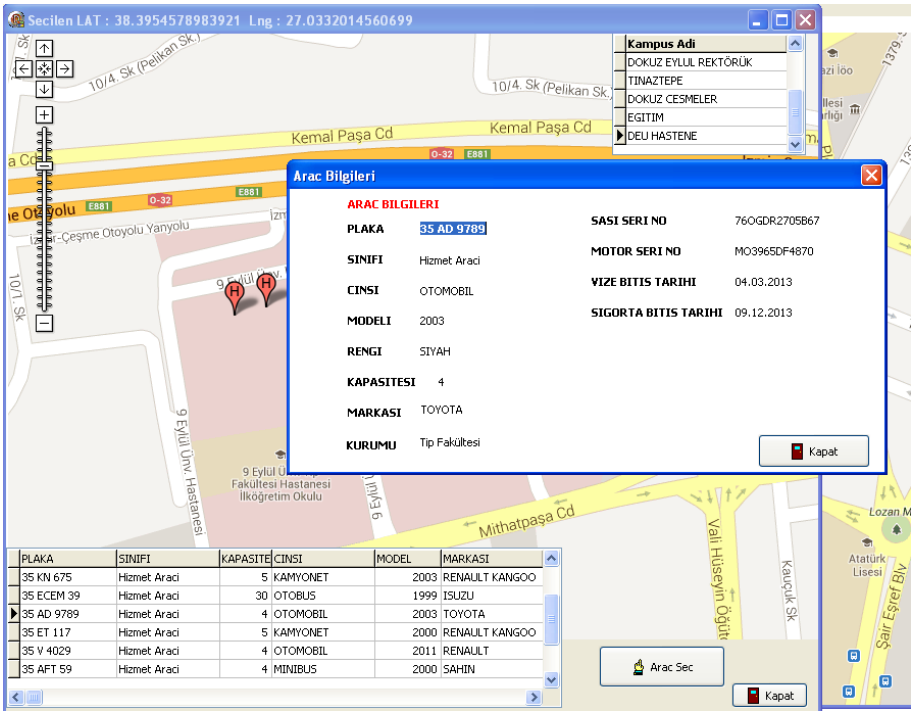


Figure 4.16 Screen view WindowsForm selected the vehicles served in the service for staff on map

Campus list in Grid List has been created in order to accelerate to be located on map. The user can be positioned to the location of campus quickly by selecting from the list. Vehicle license plate is displayed when positioning on Markers representing the vehicles and their location. There might be "H" or "G" letters on Markers. "G" represents the vehicle that has an unfinished commissioning. "H" also represents the vehicle that has no commissioning. If there is no commissioning when clicking double times, a window displaying the information of the vehicle opens. If there is any commissioning, a window displaying the existing commissioning information opens next to information of the vehicle. The photo of driver in charge is also displayed with window opened. Vehicle license plate can be transferred to the form by clicking the button "Araç Seç" after selecting the vehicle that is commissioned.



PLAKA	SINIFI	KAPASITE	CINSI	MODEL	MARKASI
35 KN 675	Hizmet Araci	5	KAMYONET	2003	RENAULT KANGOO
35 ECEM 39	Hizmet Araci	30	OTOBUS	1999	ISUZU
35 AD 9789	Hizmet Araci	4	OTOMOBIL	2003	TOYOTA
35 ET 117	Hizmet Araci	5	KAMYONET	2000	RENAULT KANGOO
35 V 4029	Hizmet Araci	4	OTOMOBIL	2011	RENAULT
35 AFT 59	Hizmet Araci	4	MINIBUS	2000	SAHIN

Figure 4.17 Screen view WindowsForm which is displayed the vehicle information as using Marker while selecting the vehicles that is served in service for staff

Information of location to go with commissioning is inserted as text and spatial data on the form. The user pops-up a window that has the digital map by clicking the button "Konum Bul". The desired location can be selected as adjusting the map scale in the desired manner by the help of the mouse. The selected location is marked with marker and displayed the values of "Longitude" and "Latitude" on the form. The values of "Longitude" and "Latitude" are ensured to display on explanation window on map by clicking on Marker. It can be searched with the data defined on the digital map. Vehicle commissionings have been usually made among campuses within university. Therefore, campus list as a Grid List on the form "Konum Bul" has been added. Likewise, the list of updated institutions by selected campus has been added. It can be located the defined location of institution quickly by making a selection in the list of institutions in campus after selecting a campus. The values of "Longitude" and "Latitude" on the location data are transferred to the form by clicking the button "Konum Seç" after selecting the location on the digital map. If there is a selected location before, the selected location is displayed on map and marked with Marker when clicking the button "Konum Bul". The user -if she/he wants- can determine a new location.

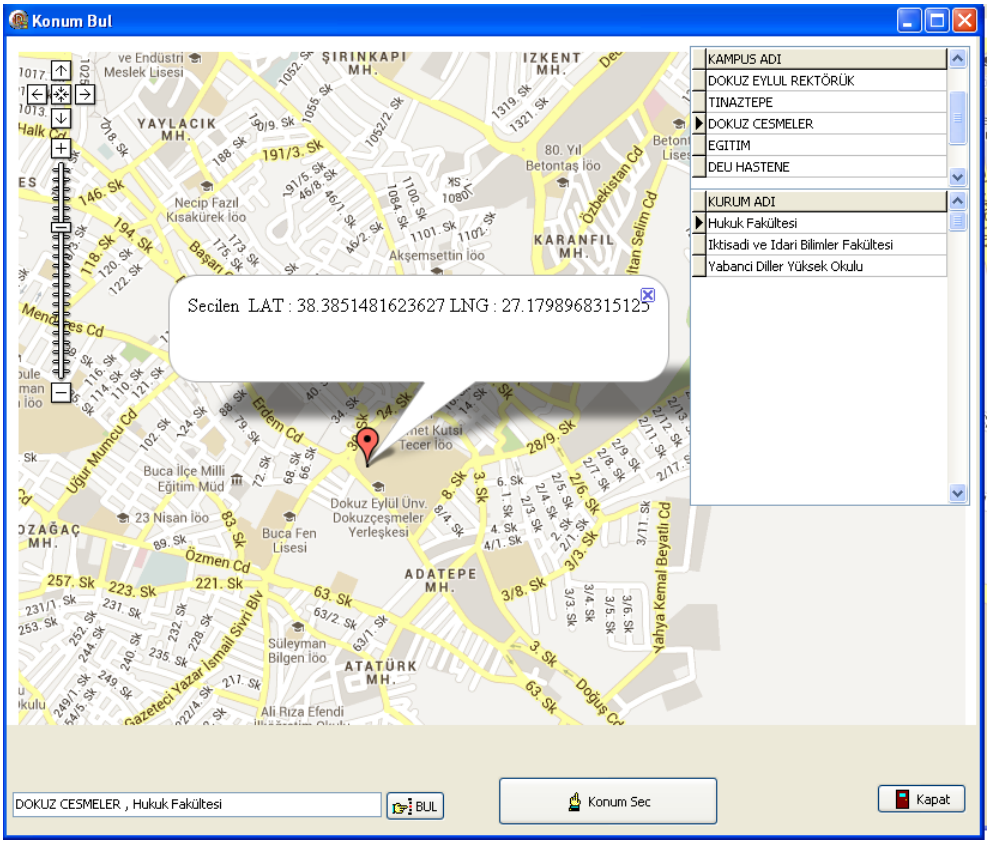


Figure 4.18 Screen view WindowsForm the location to go with commissioning which is selected on the map

Commissioning data is saved by clicking the button "Kaydet" on the form after inserting vehicle commissioning information.

4.3.3.2 Commissioning Final Completion

The vehicles have to be parked to parking space defined in the screen "Araç Bilgileri" after ending commissionings. The vehicles ending the user commissioning have to indicate te latest KM information and the ending date. A Grid List is added to the form prepared to enter the commissioning final completion. Those who did not enter the task completion date on the data entered from the form "Yeni Görevlendirme" is listed by questioning with SQL in Grid List. There are vehicle licence plates, the date and time of commissioning, the first KM information before using and the location data to go in the list. All existing commissionings can be listed

in Grid List by clicking the radio button "Tüm Görevlendirmeler" added onto the form. This is enough to select the radio button "Park Yerindeki Araçlar" in order to list the vehicles parked after using in Grid List. This data is provided as relating between parking information on the form "Araç Bilgileri" and the location data of vehicle with SQL query language. It can be reached the location of the vehicle used in the commissioning selected by clicking the button "Araç Konum". The latest location of vehicle is displayed on the digital map as marked with Marker in the window popping-up. Vehicle information and the commissioning data can be reached in window popping-up when clicking on Marker.

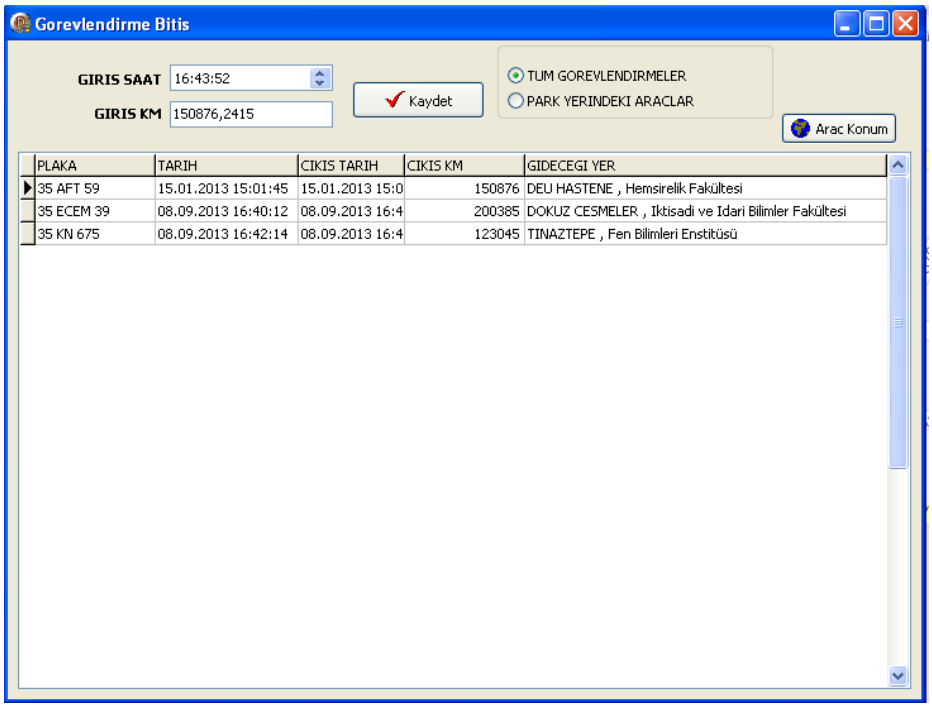


Figure 4.19 Screen view WindowsForm confirmed the commissioning of final completion data

The used vehicle's latest information in terms of KM is transferred to the form automatically when selecting a commissioning in Grid List and the system clock is transposed as the ending date of commissioning. The user can confirm the final completion information by clicking the button "Kaydet" with this window.

The existing commissionings can be checked from this form with final completion process. It can reach to the location of vehicles quickly by being listed all

commissionings. Hence, this window used as a data entry field can be also used as a reporting and checking screen.

4.3.4 Reports

Reports have been created by investigating with SQL the spatial and non-spatial data entered in the software and the data obtained with the help of GPS Tracker. The prepared reports can be reached by menu elements such as "Tarihe Göre Araç Konum", "Görev Bazlı İzlenen Yol", "Vize Tarihi Biten Araçlar" and "Sigorta Tarihi Biten Araçlar" which are under "Reports" the top menu. Grid List and Google Maps APIs are used as reporting tools.

4.3.4.1 Vehicle Location by Date

The data obtained by Gps Tracker is ensured to be reported in order to check the vehicles. The list of vehicles that location data is obtained by Gps Tracker is listed by Grid List added on the created form. DataTimePicker objects are added on the form in order to select the date and time information desired for questioning. The vehicle desired to question and the data of the time questioned can be selected by using these objects.

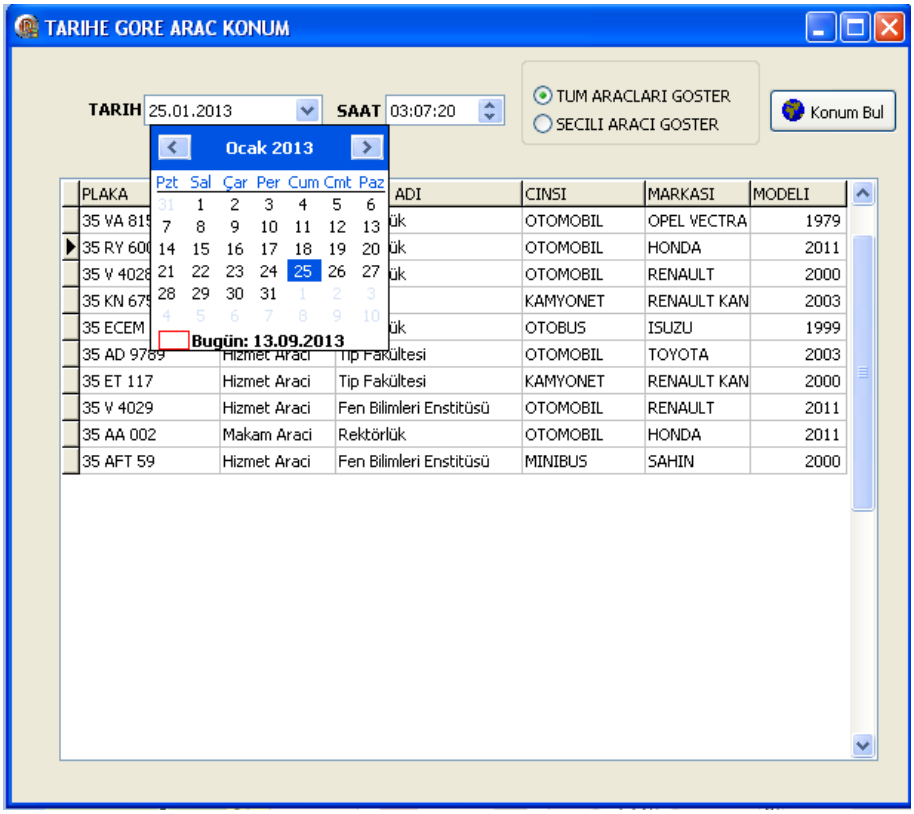


Figure 4.20 Screen view WindowsForm that the vehicle location data reached by date

When clicking the button "Konum Bul" on the form, vehicle location on the selected date or on the date closest to the selected date is shown in the pop-up "Tarihe Göre Konum Bul" window on Google Maps by marking with a marker. If the radio button "Tüm Araçları Göster" is selected, the location of each vehicle listed on the Grid List on the selected date is marked on the map with a marker. As shown in the figure 4.21, the user can reach the location of the selected vehicle on the map with the Grid List on the window "Tarihe Göre Konum Bul". The marker symbolizing positions and vehicles is found with “M” and “H” letters. “M” represents the vehicle that is an official vehicle. “H” also represents the vehicle that is a service vehicle. Vehicle licence plate and the date data that the location obtained is shown on the map when the mouse is on the marker. The vehicle information is shown on the window popping-up when clicking on the marker.

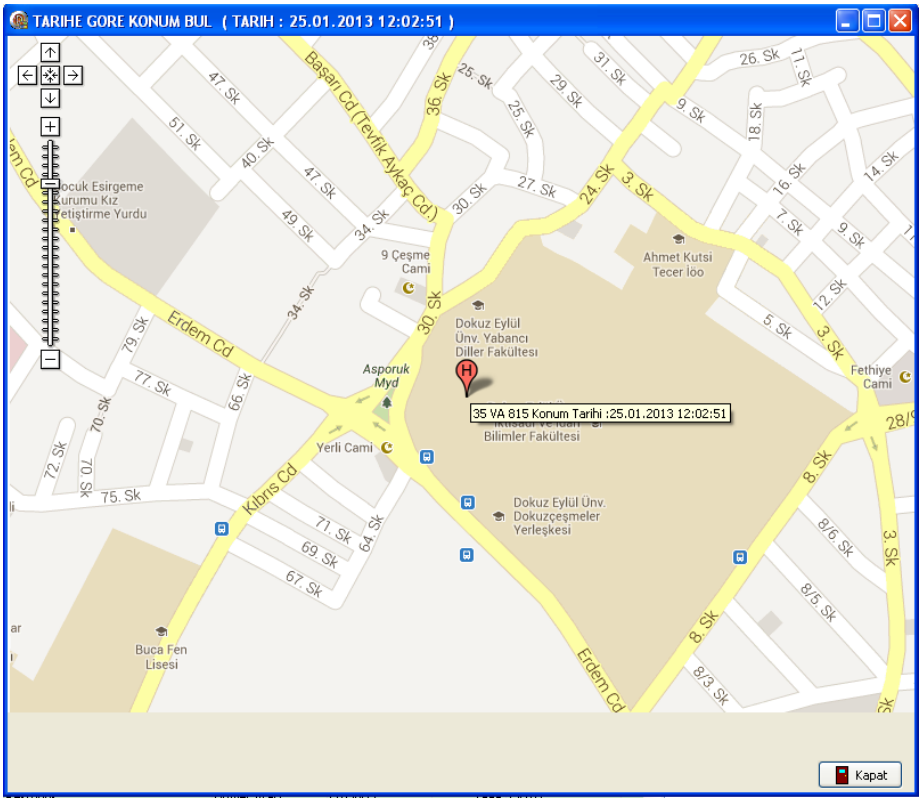


Figure 4.21 Screen view WindowsForm which the location of vehicles is shown on the map with a specified date

4.3.4.2 The Commissioning-Based Way That is Followed

The data of the road which vehicles followed is reported in the commissioning period in here. The commissionings created on the form and completed in Grid List are listed by questioning with SQL from database. The start and end date of commissioning, vehicle license plate, driver and vehicle information are presented to users on Grid List as shown in Figure 4.22. The users can select the commissioning that they want to question in here.

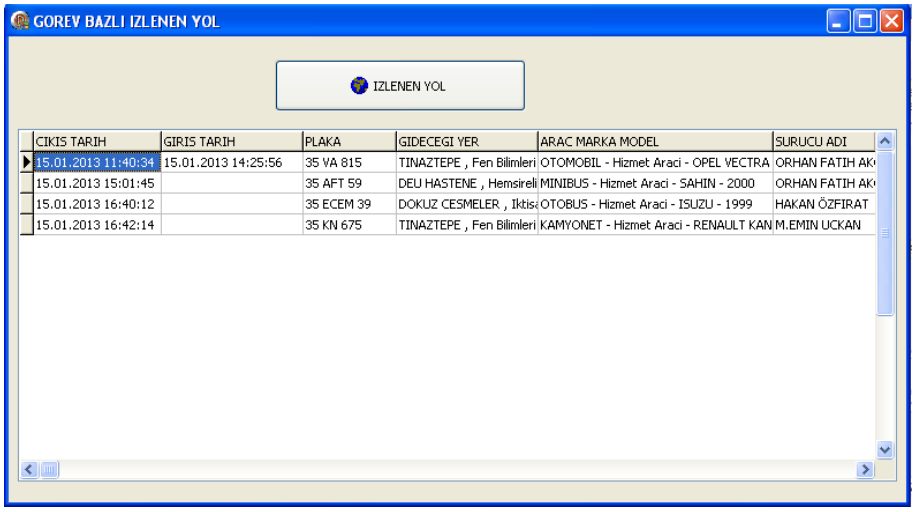


Figure 4.22 Screen view WindowsForm which commissioning is selected in order to reach to knowledge of the ways followed in the commissioning period

The button "İzlenen Yol" must be clicked by selecting the commissioning in Grid List to report the way in commissioning process. The way in commissioning process is demonstrated in Google maps on window popping-up. All location data obtained via GPS Tracker is marked with Marker on the map in commissioning process. There are "G" and "D" letters on Markers. "G" represents location that the vehicle commissioned goes. Also, "D" represents which the vehicle turns back from the commissioned location in. Lines are drawn between Markers on the map by using the date relationship obtained. Red line is drawn between the locations data obtained when the vehicle goes to the commissioned location. Blue line is drawn between the location data which the vehicle is commissioned in. Green line is also drawn between locations which the vehicle turns back from the commissioned location. When Mouse locates on Marker, the date and time of locaton are displayed on Google map. Values obtained by querying with SQL data obtained via GPS Tracker and the value of the commissioned location data on form "Yeni Görevlendirme" are used to create display like this.

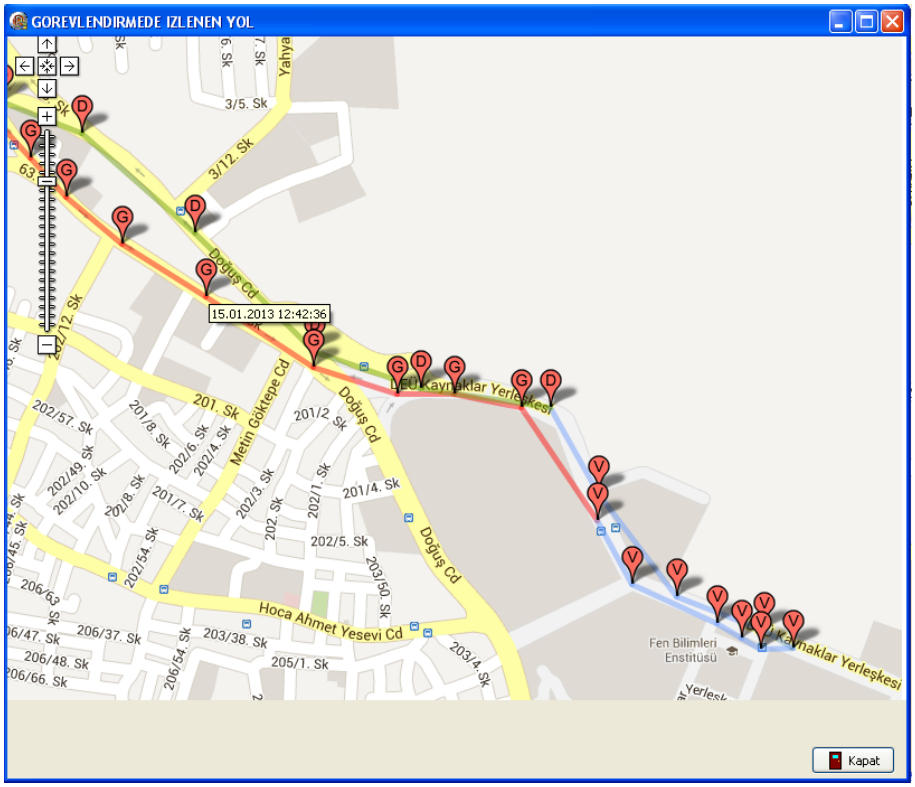


Figure 4.23 Screen view WindowsForm which the road followed by the vehicle shown on the map

4.3.4.3 Vehicles That Visa Date Expires

Vehicles' visa procedures must be done annually. Vehicles which do not have visa procedures cannot go to traffic. The visa date of vehicles must be followed by civil servants in charge. This report has been created in order to provide the timely performance of this operation. The date of visa to all cars is entered on window "Araç Bilgisi" to the field "Vize Bitiş Tarihi" by the user. Information of the vehicles that visa expiration date is a month or less than the date of report is listed on the Grid List added to the form "Vize Tarihi Biten Araçlar" by questioning with SQL as shown in Figure 4.24. The list has been created by ranking in ascending order based on the visa expiration date.

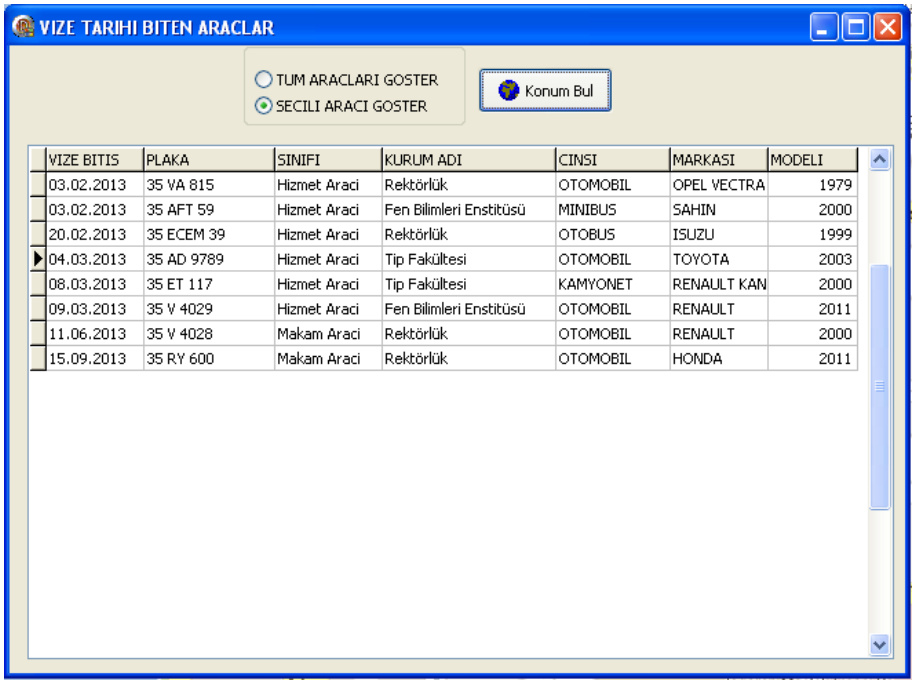


Figure 4.24 Screen view WindowsForm listed the vehicles that visa date expires

The location of vehicle selected with Grid List in reporting period can be displayed as marked with Marker on Google Map on window popping-up by clicking the button "Konum Bul". The location of all vehicles listed as selecting radio button "Tüm Araçları Göster" on form "Vize Tarihi Biten Araçlar" can be reached. The location of the desired vehicle can be reached by selecting a vehicle from the list on window popping-up as shown in Figure 4.25. The location of campus can be gone quickly by selecting in campus list shown in Grid List and the vehicles that visa date expires can be reported on map in here. The location of only vehicle selected with Grid List can be reported on map by selecting radio button "Seçili Aracı Göster". Whether the vehicle is for authority or service and whether there is any commissioning for that or not indicate with lettering on Marker on the map. Information of the vehicle and -if there is- commissioning can be reached by clicking on Marker. Hence, both information of the vehicles passing their expiration dates and the location of these vehicles can be reached with generated form.

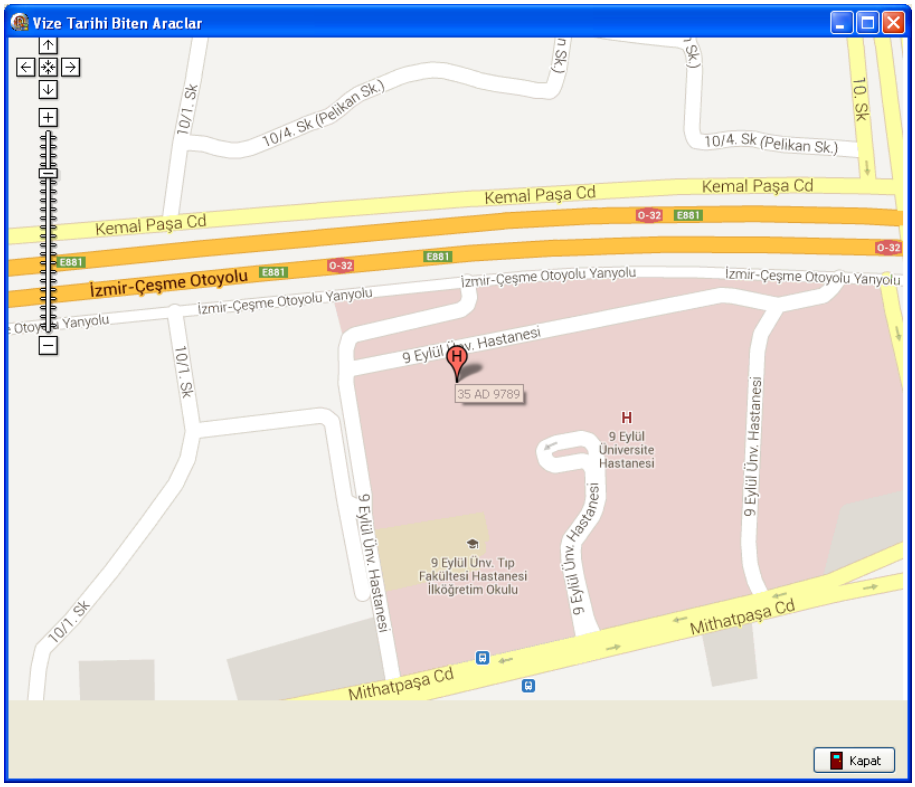


Figure 4.25 Screen view WindowsForm displaying the location of vehicles that visa date expires in reporting date

4.3.4.4 Vehicles That the Insurance Date Expires

Vehicle insurance transactions have to be done yearly. Vehicles cannot go to the traffic without insurance transactions. The expiration date of vehicles must be followed by the relevant officer. This report was created in order to provide the timely performance of this operation. Insurance renewal dates of all vehicles are entered to field "Sigorta Bitiş Tarihi" by the user on window "Araç Bilgileri". Information of vehicles that their expiration dates remain one month or less is listed by querying with SQL as shown in Figure 4.26 in Grid List added to form "Sigorta Tarihi Biten Araçlar". Vehicles with expired insurance are also listed in list. List has been created in ascending order based on the insurance expiration date.

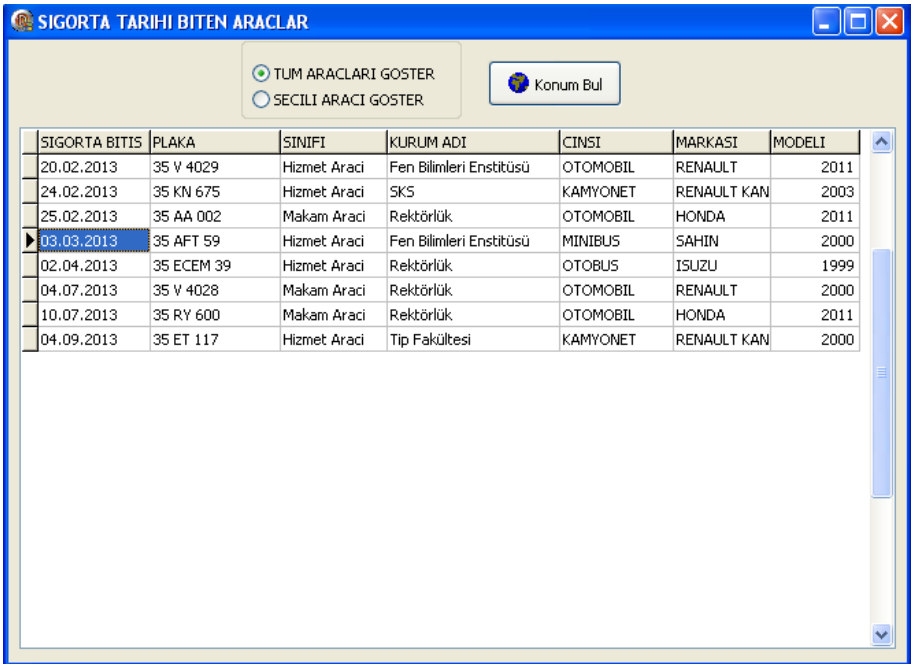


Figure 4.26 Screen view WindowsForm listed the vehicles visa date expiring

In addition to form "Vize Tarihi Biten Araçlar", The location of vehicle selected with Grid List in reporting period can be displayed in the form "Sigorta Tarihi Biten Araçlar" as marking with Marker on Google Maps on window popped-up as clicking the button "Konum Bul". The location of all vehicles listed by selecting radio button "Tüm Araçları Göster" can be reached on the form "Sigorta Tarihi Biten Araçlar". The location of vehicle selected with Grid List can be reported on map by selecting radio button "Seçili Aracı Göster". Thus, both information about vehicles that insurance date expires and the location of this vehicles can be reached.

4.3.5 View

Location data of institution vehicles can be followed simultaneously with digital map on "main form" opened when running prepared software. Grid List can be added onto "main form" to access to instantaneous locations of vehicles quickly. These lists have been created by querying with SQL for data entered to system under "Tanımlar" the top menu.

Grid List containing the information of vehicles within institution has added to "main form" by selecting "Araç Listesini Göster" at the bottom of the top menu so that the location of the vehicle selected from the list can be reached quickly. The name of this menu element has changed as "Araç Listesini Kaldır" after clicking on "Araç Listesini Göster". Grid List containing the vehicles list has removed from the "main form" by selecting the menu element called "Araç Listesini Kaldır". The name of this menu element has changed as "Araç Listesini Göster" after clicking on "Araç Listesini Kaldır".

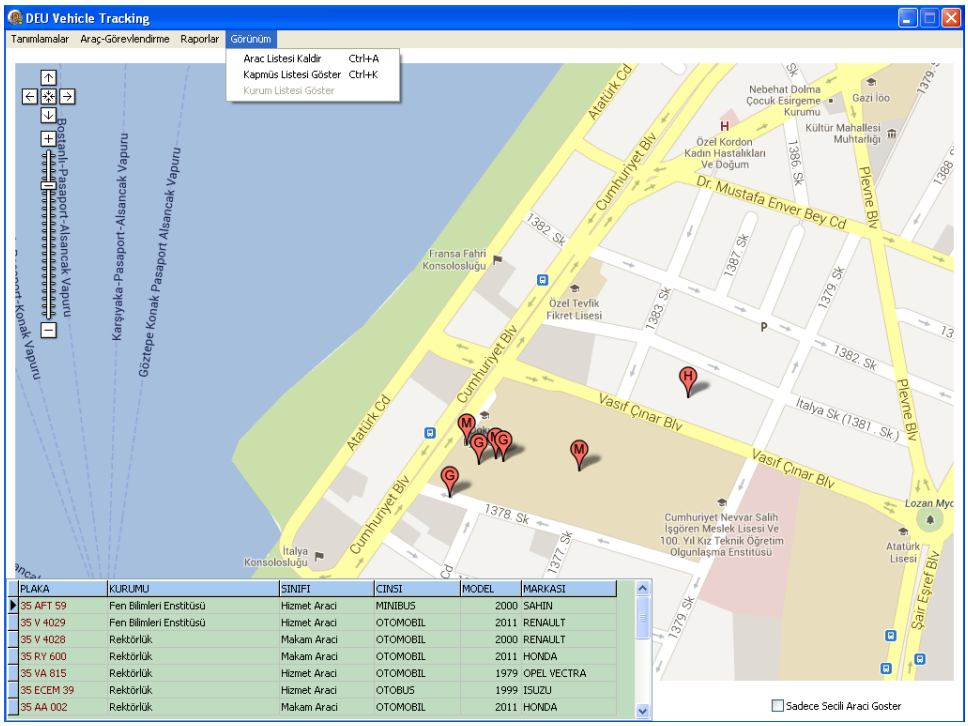


Figure 4.27 The addition Grid List containing the vehicles list on Main Windows Form monitoring the current location of the vehicles

"Sadece Seçili Aracı Göster" CheckBox is added to Main Form when selecting "Araç Listesini Göster" under the top menu "Görünüm". The vehicle selected with Grid List is shown on the map when the CheckBox is selected. Also, all vehicles are shown on the map when the CheckBox is not selected.

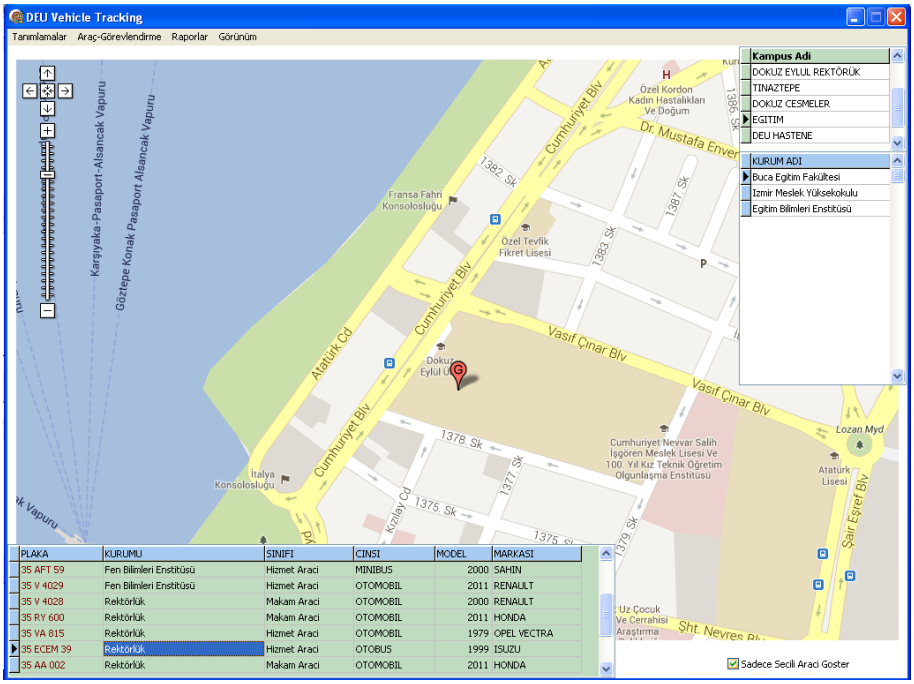


Figure 4.28 Displaying the only selected vehicles on the map on Main Windows Form tracked the existing location of vehicles

"Kurum Listesini Göster" which is passive is not active unless selecting "Kampüs Listesini Göster" at the bottom of the top menu. The name of menu element changes as "Kurum Listesini Göster" when selecting "Kampüs Listesini Göster". Grid List listed campus on "main form" is added when selecting "Kampüs Listesini Göster". The location of campus can be reached quickly by selecting from Campus list in Grid List. Grid List listed institutions on "main form" is added when selecting "Kurum Listesini Göster" if it is active. Institutions list has been updating depending on selected campus when selected campus information changes. The location of institution can be reached quickly by selecting institutions list in Grid List. The name of menu element changes as "Kurum Listesini Kaldır" when selecting "Kurum Listesini Göster". When "Kurum Listesini Kaldır" selects as a menu element, institutions list is removed from "main form" and the name of menu changes as "Kurum Listesini Göster". When "Kampüs Listesini Kaldır" selects as a menu element, campus list and -if it is added- institutions list is removed from "main form". "Kampüs Listesini Kaldır" the menu name changes as "Kampüs Listesini Göster" and "Kurum Listesini Göster the menu element switches to passive mode.

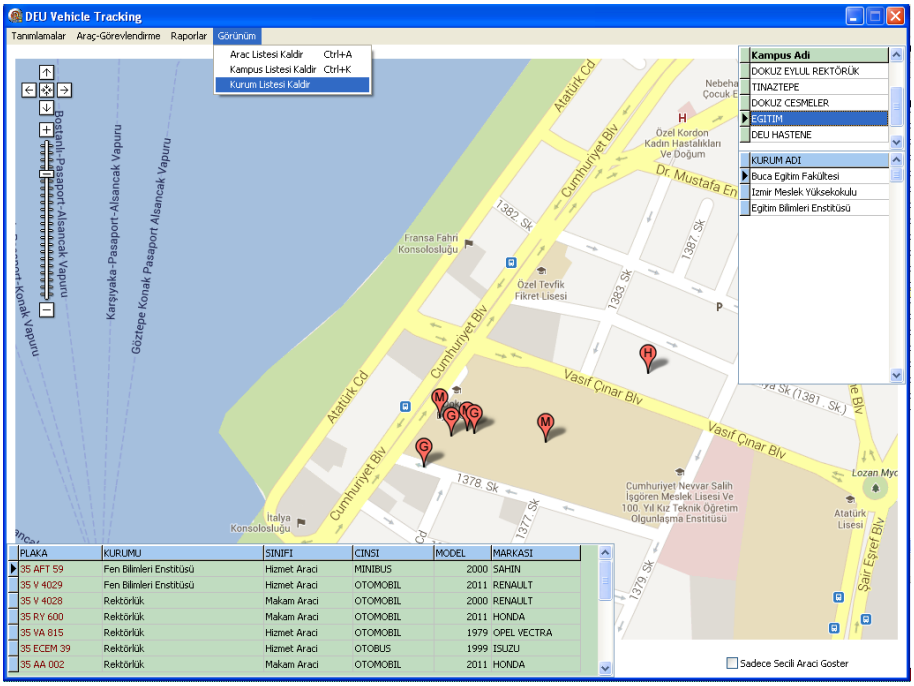


Figure 4.29 The remove Grid List containing institutions and campus list on Main Windows Form monitoring the current location of the vehicles

CHAPTER FIVE
CONCLUSION AND FUTURE WORKS

GIS-based computer software is rapidly increasing with the development of today's technology. Obtaining spatial data quickly via GPS and presentation of digital maps to users by many service providers have a major impact on this. Increasing the use of internet and the speed of access to information are also effective in the development of GIS software. GPS is now available as standard equipment on mobile phones, tablets and cars. Not only to view spatial data on digital maps, but also to interpret a lot of information at the same time on these maps is used as effective methods to quick access to information. Functions and tools are available as standard to access the digital maps on new versions of the Web-based programming languages. Companies developing database such as Oracle create new “table columns” that digital maps can be saved on their new versions and they also work to increase the speed of data access. Social networking sites are established based on digital maps and spatial data. GSM companies and private sector companies are developing Web-based systems that serve the users and institutions with vehicle tracking systems.

Today, GIS-based systems show development very quickly in the private sector. Public institutions have to follow developing technology and they have to establish their existing systems with the help of these technologies. Deficiencies in the management and supervision of the vehicles used in public institutions have been identified. GIS-based vehicle tracking system has been established in order to eliminate the problems identified and to benefit from the developing technological structure. Dokuz Eylül University has been selected as the workspace. Sample software has been prepared to provide follow-up, management and control of the vehicles used within the institution. When designing the structure of software, computer software and database that are available in different units within the institution have been investigated. Law and the created structure for using the vehicles within the institution have been examined.

Accelerate the process of decision-making is intended by presenting a lot of data at the same time effectively to users with established system. Digital maps are provided user with using as a means of both creating data and reporting in the software. GIS-based software created provides users with management of vehicles in a system, supervision of them as a legal requirement and reporting a lot of data at the same time quickly. It is intended that system administrators can carry out their work easier and more accurate information.

It is not necessary to establish a system for the software created with Delphi used as a programming language. It is used by installing to the computer which it will be used. This is also an effective method in terms of security. Oracle used as database is a system which its structure has been created in Dokuz Eylül University selected as the workspace. That's why it is designed as a system that the active use of GIS-based system prepared can be performed quickly.

Created vehicles tracking system has a structure that can be improved easily. In accordance with the request of institutions, software is aimed to be developed and used by making changes and additions on vehicles tracking software. Data obtained with the use of this system can be reported by investigating in different platforms. It is other application aimed to report the generated data by using digital maps to ensure the management's controlling this data from their mobile phones and tablets by using vehicle tracking system in the institution.

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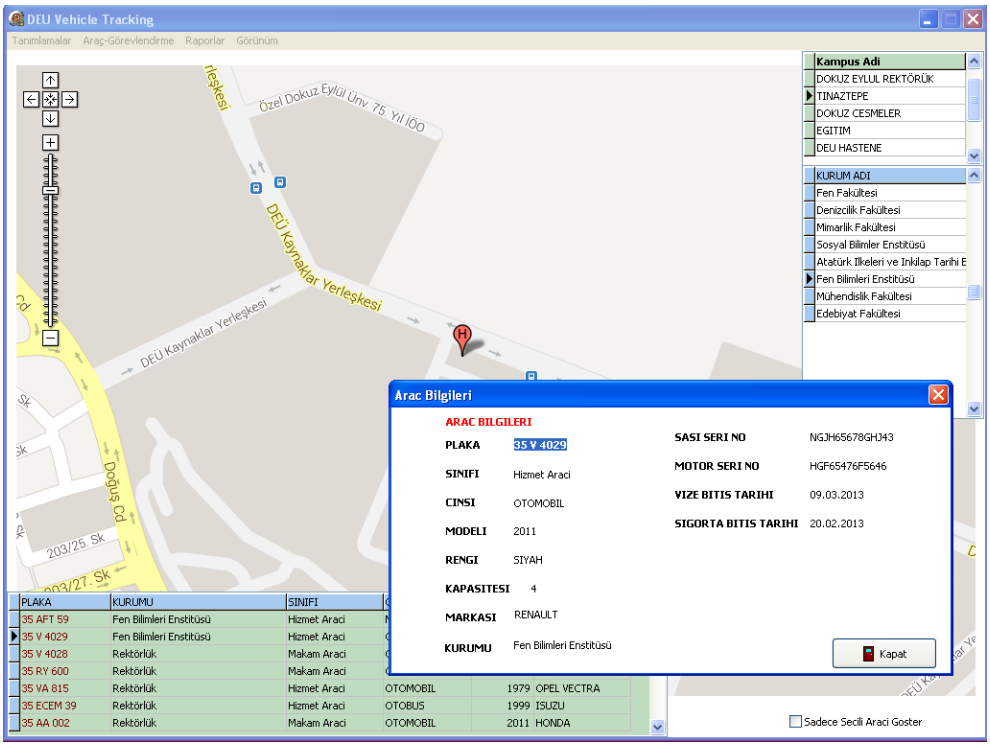
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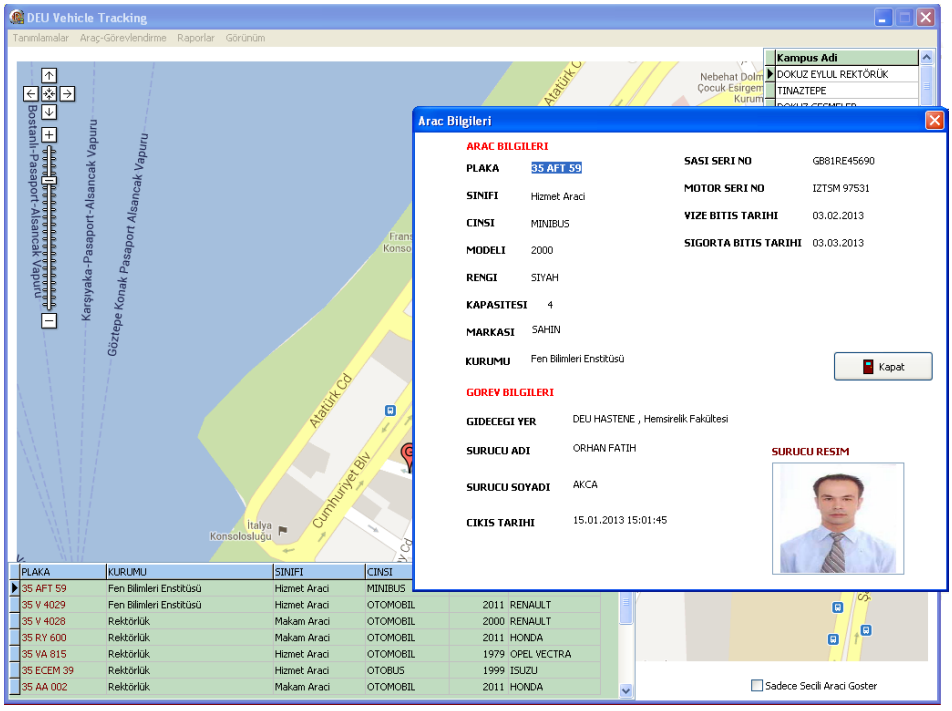
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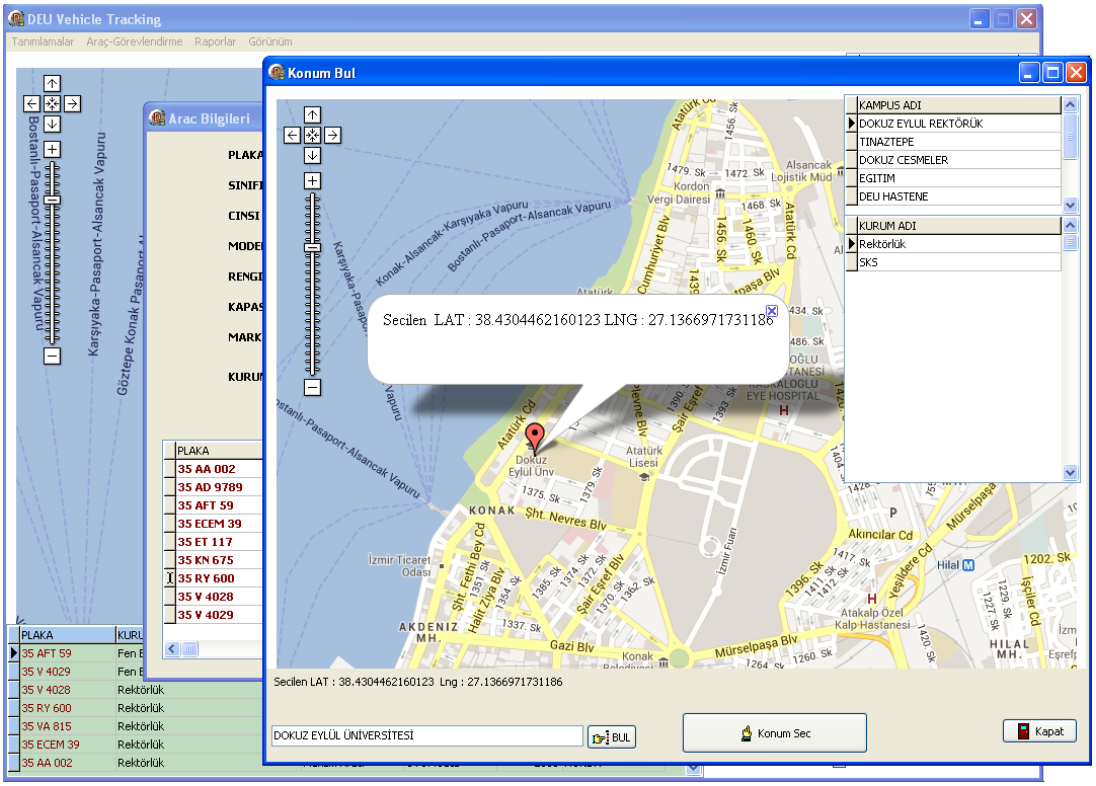
APPENDICES



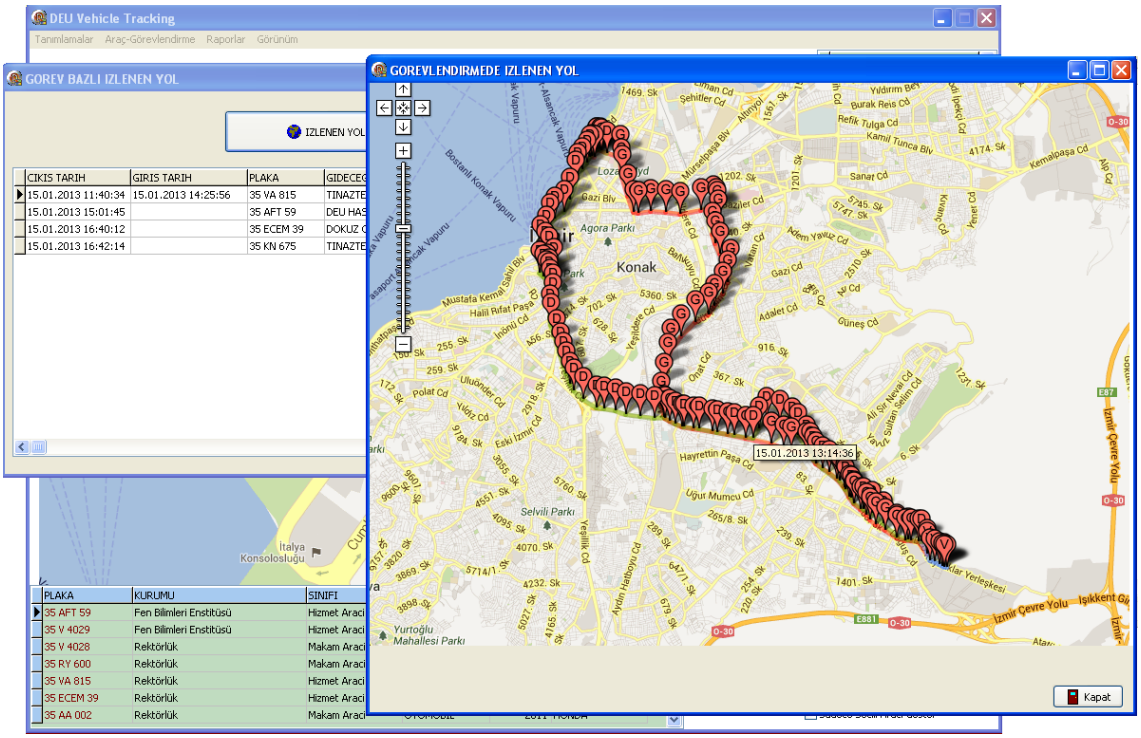
Screen view which is displayed the vehicle information



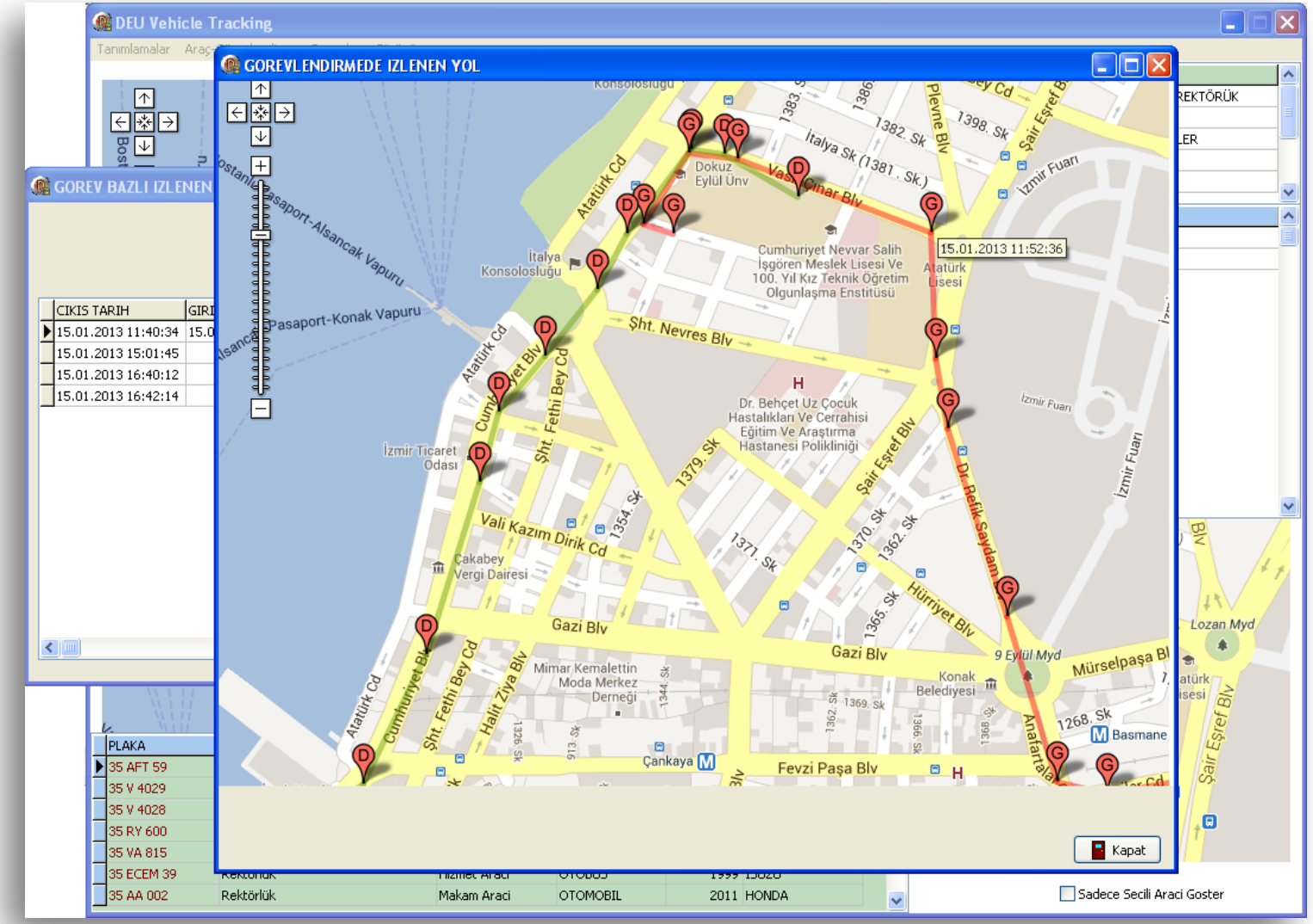
Screen view MainForm which is displayed the vehicle information and commissioning information



Screen view selecting the location that the vehicles are parked on the map



Screen view which the road followed by the vehicle shown on the map



Screen view which the road followed by the vehicle shown on the map