

AN IMPROVED SPATIO-RELATIONAL DATABASE DESIGN FOR URBAN
CONSERVATION AND ITS PERFORMANCE ANALYSIS

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ABSTRACT

AN IMPROVED SPATIO-RELATIONAL DATABASE DESIGN FOR URBAN CONSERVATION AND ITS PERFORMANCE ANALYSIS

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The conservation of historic urban areas is multi-faceted and multi-disciplinary decision-making process. There are different types of data that are useful for understanding historical settlement and making decisions that will help conserve and revitalize historical and cultural values. It is important to integrate these different kinds of data in a single place (web-based application with database) and enable sharing of data with different actors and stakeholders (municipality, conservation council, residents, etc.). While, Conservation Councils of Cultural Properties and Municipalities are effective participants in the decision-making process; on the other hand, stakeholders are affected as a result of decisions taken by various governmental institutions.

Databases are one of the important systems to control data redundancy and maintain the data consistency. They provide many advantages such as data integration which helps easy in retrieving data, updating data and sharing.

In this thesis, we use different kinds of data prepared within CDP (Conservation Development Plan) project such as vector maps, aerial and satellite photographs, relational databases, thematic analysis maps, spreadsheets, documents and archive files of historical Odunpazarı. These data have been obtained from various institutions and integrated in a Web-based GIS application for efficient decision making and management of a historical town. Then, obtained data and documents will be published via Internet to target stakeholders.

Original database had an unsuitable design for using in web-based application and needed to be improved for better and faster database query performance. In this thesis, an improved database was designed and query performance was measured comparing to original database.

Web-based GIS can be a very useful tool in developing web-based user interfaces that can present useful information about historical and cultural sites to individuals as well as government institutions which must use information while making planning decisions. In this thesis, a survey was made about web-based GIS usage in urban conservation as a web-based tool. Also the capability of the web-based GIS in urban conservation was examined. By improving a web-based urban conservation tool, an efficient web-based GIS bringing various types of data together and sharing them with different stakeholders was realized.

In order to make best use of a centralized web-based system, the implementation of web-based urban conservation tool has been developed as a server-side application consisting of a web server and database server. Different kinds of programs and software libraries mostly open source have also been used for this application.

The improved database design and the web-based application have shown that, with the help of Internet; members of the institutions and stakeholders can easily access all kinds of data in a single web site by using the developed web-based GIS application. Web-based GIS application is expected to improve the accuracy and speed of decision-making and also makes the whole process easier. Because of these abilities, web-based GIS have been expanding rapidly in the recent years and it is a valuable tool for the field of urban conservation.

Keywords: Database, Geographic Information System (GIS), Web-Based GIS, Urban Conservation.

ÖZ

KENTSEL KORUMA İÇİN İYİLEŞTİRİLMİŞ BİR MEKAN-İLİŞKİSEL VERİTABANI TASARIMI VE PERFORMANS DEĞERLENDİRMESİ

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Tarihi kentsel alanların korunması çok yönlü ve çok disiplinli bir karar verme sürecidir. Tarihi çevreleri anlamaya ve tarihi ve kültürel değerlerin korumasına ve yeniden canlandırılmasına yardımcı olacak kararlar üretme konularında faydalı olan birçok veri kaynađı ve veri tipi vardır. Bu farklı verilerin tek bir yerde toplanması ve bu verilerin farklı paydaş, aktör ve hak sahipleri (belediye, koruma kurulu, vatandaşlar, vb.) ile paylaşılması önemli bir konudur. Kültür Varlıklarını Koruma Kurulu ve Belediyeler karar verme sürecinde etkin olan aktörler iken, vatandaş/hak sahipleri ise devlet kurumları tarafından verilen kararlardan etkilenen paydaşlardır.

Veritabanları, veri fazlalığını kontrol eden ve veri tutarlılığını koruyan en önemli sistemlerden biridir. Veri entegrasyonu ile ilgili, verilerin kolay bir şekilde alınması, düzenlenmesi ve paylaşılması gibi birçok avantaj sağlamaktadırlar.

Bu tezde, büyük çoğunluğu KAİP (Koruma Amaçlı İmar Planı) projesi kapsamında hazırlanmış, tarihi kent Odunpazarı'na ait sayısal haritalar, uydu görüntüsü, hava fotoğrafı, veri tabanları, tematik analiz haritaları, belgeler, arşiv dokümanları gibi farklı kurumlardan alınan farklı tür veriler kullandık. Bu veriler tarihi kentle ilgili daha verimli karar verebilmek ve yönetebilmek için web-tabanlı CBS uygulaması ile bütünleştirilmiştir. Daha sonra ise elde edilen veriler ve kararlar internet üzerinden yayınlanarak paydaşlar/katılımcılarla paylaşılmıştır.

Belediyeden temin edilen orijinal veritabanı web-tabanlı uygulamada kullanmak için uygun yapıda değildi ve daha iyi ve hızlı veritabanı sorgu performansı için geliştirilmesi gerekiyordu. Bu tezde geliştirilmiş bir veritabanı tasarımı yapıldı ve orijinal veritabanı ile karşılaştırılarak sorgu performans ölçümleri yapıldı.

Web-tabanlı CBS'leri, geliştirilen web tabanlı kullanıcı arayüzleri ile tarihi ve kültürel sit alanları hakkındaki işe yarar bilgileri plan kararları üretebilmek için bilgiye gereksinim duyan devlet kurumlarına sunabilen önemli bir araç olarak düşünülebilir. Bu tezde, web-tabanlı CBS'nin kentsel koruma alanında web tabanlı bir araç olarak kullanılabilirliği ile ilgili bir gözlem yapılmış ve yetenekleri incelenmiştir. Web-tabanlı bir kentsel koruma aracı geliştirerek, verimli bir web-tabanlı CBS ile farklı kaynaklardan temin edilen farklı tür verilerin bir araya getirilebileceği fark edilmiştir.

En iyi şekilde merkezi bir web-tabanlı sistem oluşturabilmek için, web tabanlı kentsel koruma aracı web sunucusu ve veritabanı sunucusu içeren bir sunucu-tarafli mimari ile geliştirilmiştir. Bu web-tabanlı uygulamada çoğunluğu açık kaynak kodlu olan birçok farklı program ve yazılım kullanılmıştır.

Bu geliştirilmiş veritabanı tasarımı ve web-tabanlı uygulama göstermiştir ki, internetin de yardımıyla kurum çalışanları ve diğer paydaşlar/katılımcılar bu geliştirilen web-tabanlı uygulamayı kullanarak verilere tek bir internet sayfası üzerinden kolayca erişebileceklerdir. Web-tabanlı CBS'nin karar verme sürecinin doğruluğunu ve hızını artırması ve tüm bu süreci daha kolay hale getirmesi beklenmektedir. Bütün bu yetenekleri nedeniyle web-tabanlı CBS kullanımı son yıllarda hızla artmaktadır ve kentsel koruma için de değerli bir araç haline gelmiştir.

Anahtar Kelimeler: Veritabanı, Coğrafi Bilgi Sistemleri (CBS), Web (İnternet) Tabanlı Coğrafi Bilgi Sistemleri, Kentsel Koruma.

To My Beloved Family

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LIST OF ABBREVIATIONS

API	: Application Programming Interface
ASP	: Active Server Pages
CAD	: Computer Aided Design
CDP	: Conservation Development Plan
CIPA	: Committee for Documentation of Cultural Heritage
CSS	: Cascading Style Sheets
DBMS	: Database Management System
FTP	: File Transfer Protocol
GIS	: Geographic Information System
GUI	: Graphical User Interface
HTML	: Hyper Text Markup Language
HTTP	: Hyper Text Transfer Protocol
ICOMOS	: International Council on Monuments and Sites
IT	: Information Technology
LAN	: Local Area Network
NCGIA	: The National Centre of Geographic Information and Analysis
OGC	: Open Geospatial Consortium, Inc.
PHP	: Personal Home Page / Hypertext Pre-processor
RecordDIM	: Recording, Documentation and Information Management
SIS	: Spatial Information Systems
SQL	: Structural Query Language
TIN	: Triangulated Irregular Network
WCS	: Web Coverage Service
WFS	: Web Feature Service
WMS	: Web Map Service
WWW	: World Wide Web

CHAPTER 1

INTRODUCTION

1.1 Statement of the Problem

There are many different types of data which are useful firstly for understanding historical settlement, then evaluating and making decisions. These data comes from different places such as Conservation Councils of Cultural Properties, Municipalities, Provincial Directorates of Land Registry and Cadastre in different formats like vector data, raster maps, databases, etc.

It is crucial to integrate these different kinds of data in a common place (database and information system) and share data with different actors, and stakeholders. In this integration and sharing process, Web-based GIS with an improved database design is an essential technology and tool. Web-based GIS technology has the capability of data integration with the help of the improved database design. It is also capable of data sharing with target audiences via different web interfaces at the same time.

An improved database design is needed for ensuring consistent data, eliminating data redundancy and doing efficient queries with high performance. Despite the original database, designed database should only store useful and required data. Designed database should be normalized to eliminate unnecessary large volumes of data. Designed database should have tables of possible values and keys to refer to the values. By doing these improvements, data inconsistency, data redundancy and duplication can be eliminated. A well-designed and improved database use simpler queries and fast execution. Performance of a database is dependent on the design.

To sum up, there are many different data types, and they all scattered in different institutions. The processes of data exchange, communicate and correspondence between Conservation Council of Cultural Properties and Municipalities is

progressing very slowly and taking a long time. Because of all these mentioned reasons; the involvement of different actors in the decision making process has become difficult; the decision-making process is proceeding very slowly; all the data necessary for urban conservation decision-making process are not always available or accessible. Consequently, these generate important problems and deficiencies in urban conservation decision-making process including the preparation of the conservation aimed development plans. Hence, it becomes necessary to provide new tools, methods and processes for making the urban conservation decision-making process consistent, efficient, participatory as well as labor and timesaving.

1.2 Objectives and Scope of the Thesis

Main objectives of the study are to improve a new and more powerful database design and an easily accessible and useful web-based urban conservation tool to help the documentation, decision-making, management and data sharing processes of the conservation of historical Odunpazarı and data sharing with participants. For this purpose, digital data from various sources in different types are brought together. With the help of this study, architectural and structural characteristics of the buildings and related documents in the historical part of Odunpazarı are transferred into the improved database design. Then, this improved database is integrated with the web-based information system. Web-based urban conservation tool is designed to build an internet based information system with an improved database design and customized queries for urban conservation.

This study is looking for answers for the problems mentioned in the statement of the problem. An improved database is designed to integrate different kinds of data, databases and sheets of historical Odunpazarı taken from different institutions. After that, the study is aimed to integrate the improved database design, aerial and satellite photographs, thematic analysis maps and archive files into the Web-based GIS environment by developing a web-based urban conservation tool for efficient urban conservation process. Then, it is aimed to publish obtained results via internet with the designed web-based urban conservation tool for target audiences.

With the help of internet which is the fast way to reach the information and knowledge, such a web-based urban conservation tool is become helpful to institutions, participants, stakeholders and tourists for reaching more data in an easy

way. This study is a good reference for future studies with improved database design and designed web-based urban conservation tool.

The reason for choosing this thesis subject is that, conservation of our historic settlements is crucial for our history and culture. For successful conservation studies, usage of multi-functional and capable technologies and a well-designed and improved database design are required. Web-based urban conservation tool with the improved database designed could be the right tool with its developing abilities.

1.3 Methodology

In the beginning of the study, literature was reviewed. First of all, the meaning of urban conservation and processes such as decision making process, conservation plan preparation process and stakeholders/participants of the urban conservation were surveyed. Earlier studies about urban conservation were researched. Then, capabilities of GIS and web-based GIS technology and their application were investigated. After that, usage of web-based GIS in urban conservation studies was conducted.

After literature review, an improved database is designed to collect different kinds of data (vector data, databases, sheets, etc.) about Odunpazarı urban site area and historic structures obtained from different institutions together in a single database. Most of the data was taken from Odunpazarı Municipality. Other institutions are Eskişehir Provincial Directorate of Land Registry and Cadastre and Eskişehir Regional Conservation Council of Cultural Properties.

In 2010, Odunpazarı Municipality made a project named Odunpazarı Conservation Development Plan (Odunpazarı CDP) with a crowded project team of architects, city planners, art historians, landscape architects, restorers and construction technicians, which is controlled and approved by Eskişehir Regional Conservation Council of Cultural Properties. In the process of the Odunpazarı CDP, members made site survey studies. With site survey studies, they collected information about historic structures and people living in the urban site area. Structures Information Sheets were prepared by project members. They made thematic maps and statistical analysis by using collected information. After analysis, they prepared and revised Odunpazarı Conservation Development Plan. Likewise, they produced the analysis on the

“Current Status of Buildings” and “Decisions about Buildings”. Additionally, they archived the related documents about buildings and citizens. They also provided aerial and satellite photographs of the urban conservation site. All these data were taken from Odunpazarı Municipality. Land registry records were taken from Eskişehir Provincial Directorate of Land Registry and Cadastre. Registration Sheets were taken from Eskişehir Regional Conservation Council of Cultural Properties.

Original database, which was designed within the context of Odunpazarı CDP, was obtained from Odunpazarı Municipality as a MS Access database file, so as to provide a basis for developing the improved spatio-relational database design and web-based application for Odunpazarı urban conservation site within the scope of this thesis. Original database has an unsuitable design for using in web-based application. Original database was needed to be improved for better and faster database query performance. Because of these reasons, an improved database is designed in PostgreSQL.

In the preparation process, before the data integration with the web based application, all the taken raster thematic analysis maps, conservation aimed development plan, satellite image and aerial photograph were geo-referenced with GIS technology and then saved as geo-tiff files. Then, vector data was saved as shapefile (shp) file format and transferred to PostgreSQL as a spatial data with the help of PostGIS. After that, vector and raster data were transferred to Geoserver and published. EPSG codes and styles of vector data layers are defined in Geoserver.

Choosing the most proper programming language is an important issue before constructing a web-based GIS system. An open-source server-side scripting language is easy to develop and provide fast access to various database systems. Therefore, server side architecture was chosen as Web-based GIS system architecture for case study and system was designed as a server-side web-based application. PostgreSQL was chosen as the database server. Geoserver was chosen as the application server and MS IIS was chosen as the web server.

Web-based GIS application was designed with MS Visual Studio using C# and JavaScript programming languages. PostgreSQL and PostGIS integration to web application, HTML content definition, etc. were coded with C# (cs) language. Scripts are crucial for web based applications. Java Script files were used for jQuery, jSon

and OpenLayers integration, identification of the application's projection (EPSG) and mainly used for defining application's functions, capabilities, how they work and which data they use. Moreover, Web-based GIS application interface was prepared with MS Visual Studio with CSS3 and HTML5 technologies. Styles of the web pages were described in CSS (css) files. Data services and web services were defined with ASP.NET (aspx, asmx, asax etc.) web application development technology.

At the end, whole different kinds of data (vector and raster data, databases, documents and sheets) were combined. After web-based GIS application designed, these inputs were transferred into web-based GIS environment. Project was published, after all configurations were done in Visual Studio. The web-based GIS application and interfaces were designed differently for three user groups, so three user interfaces and websites were defined for each user group. Web-based GIS applications interface and user capabilities were described differently from each other according to needs of users. Published websites were added into Microsoft IIS (Web Server). Then, site names, physical paths of the files and port information were given. Advanced settings like user permission assignment were made for each web site. And then Application Pools advanced settings were made. Websites serve web-based application in different ports or web addresses.

1.4 Organization of the Thesis

The outline of the thesis is as follows;

In the second chapter; a literature review is made about urban conservation and web-based GIS. Definition and importance of urban conservation, international charters and guiding documents, decision making process and actors/stakeholders are described. GIS and Web-based GIS technologies with architectural types and components, usable software and technologies and open specifications for web-based GIS are defined briefly. Lastly, Web-based GIS usage in urban conservation is reviewed and all these subjects are discussed in this chapter.

In the third chapter, an improved database design is described and experimental query performance measurements and results are evaluated. At first, original database structure and its inadequate features are discussed. Then, designed new

database structure and its properties are described. After that, experimental measurements and results of original database and designed database are compared.

In the fourth chapter, development of web-based urban conservation tool is described step by step. Stages of the study which includes obtained data types and where they were taken from, designing the web-based urban conservation tool, established relations between data types in web-based GIS application are presented briefly. Process of designing system architecture, needs of user groups and designing web application interfaces according to their needs (web page) are mentioned. At the end of this chapter, web-based application and benefits are discussed.

In the fifth chapter, studies done in the thesis and concluding remarks are given briefly. A need for well-designed and powerful database design and recommendations about web-based GIS technology usage related to urban conservation are mentioned. At the end, outcomes and future works of the study are discussed.

CHAPTER 2

WEB-BASED GIS FOR URBAN CONSERVATION

2.1 Urban Conservation: A Multi-Actor/Multiple Stakeholder Decision Making Process

Historic towns and buildings are important witnesses of the cultural and spatial sense of the past. While conservation was only about protecting important historic monuments when it first occurred in late 19th and early 20th century, the concept broadened in time, covering conservation and sustainability of the identity, values and cultural significance of all the tangible and intangible aspects of historic rural, urban and cultural landscapes.

According to Eruzun [14], there are three main particular purposes in conservation;

- Transmission of the historical heritage to future generations
- Provision of cultural continuity
- Provision of new possibilities for people to live together with the history

All these purposes require a well documentation and understanding of the existing heritage to achieve a successful decision-making.

Registry records of buildings, analysis of structures conditions, conceptual and graphic documentation are necessary for protecting the cultural heritage and transferring traditional urban texture to the future generations. Cultural continuity should be ensured, and the best way of ensuring historical and cultural continuity is conservation of historic cities.

Decision-making process of conservation of historic buildings consists of three main stages which are survey & analysis, evaluation and decision. In survey & analysis stage, field studies and surveys are done; briefly the data collection process is

performed. Then analysis is performed by using collected data. In the evaluation stage, the analyses are evaluated. In decision-making stage, decisions are made after analysis of structures current situation and evaluation. Making accurate analyses and producing the right decisions are crucial to conservation studies.

In urban site areas which are determined in accordance with *the Law 2863 on Protection of Cultural and Natural Heritage* [38], considering the interaction of the transition zone areas, conservation aimed development plans are being prepared to protect cultural and natural assets in accordance with the principles of sustainability. Municipalities are the authorized institution for preparing development plans; however, development plans must be approved by Conservation Council of Cultural Properties to be valid. Planning decisions are prepared with the participation of related chambers, civil society organizations, relevant departments of the Universities and the citizens living within the conservation area.

Principles of Conservation Development Plan (CDP) preparation in accordance with *The Regulation Relating to the Principles and Procedures of the Preparation, Implementation and Supervision of the Conservation Plan* [39];

- Historic environments, social, cultural and economic characteristics, technical infrastructure, social reinforcement, building and street textures, ownership status, transportation and circulation system, etc. situations are examined and associated with the whole city.
- Strategies are determined to solve the problems identified in conservation areas, to protect historical, cultural and natural environment in a sustainable and liveable manner.
- Strategies are determined to make structures in the conservation area safer and resistant to natural disasters.
- Research is made about characteristics of the conservation area, historical, cultural and natural structure, and an assessment is made. Then, usage decisions and construction conditions are determined.
- Inventory studies about registered and candidate to be registered cultural properties are carried.
- Renewal areas and prohibited construction areas are determined.

As mentioned above, preparation of development plans and conservation studies are extensive processes that require proper analysis and accurate decisions. In the process of preparing conservation aimed development plans and giving new decisions over time, various types of data are required. Data that needed should be easily accessible for decision-makers.

2.1.1. Main Principles of Urban Conservation according to International Charters and Guiding Documents

Urban conservation has been an important conservation and planning issue especially since the World War II. It has been a subject in discussion and development since then. During this process, International Governmental Organizations such as UNESCO, European Union, ICCROM and Non-Governmental Organizations such as ICOMOS played a leading role in defining the main principles and attitudes towards urban conservation through the international charters and guiding documents they provide as a result of the international meetings that they organize regularly on different aspects of urban conservation [9].

ICOMOS assumes that international charters should be prepared for the conservation of historic towns and urban areas that adversely affected with urban development and industrialisation [40].

Among all these international charters and guiding documents, ‘The Burra Charter’, ‘The Washington Charter’ and ‘The Valletta Principles’ play a special role. The principles, processes and attitudes defined by these three main charters are still the most contemporary and valid ones on urban conservation.

2.1.1.1 The Washington Charter

‘The Washington Charter’, also known as “*Charter on the Conservation of Historic Towns and Urban Areas*”, has emerged as a result of the ICOMOS meeting held in Washington in 1987. ‘The Washington Charter’ is important for the identification of the basic principles relating to the conservation of the historic towns and urban areas, processes, methods and tools [9].

‘The Washington Charter’ concerns historic urban areas together with natural and man-made environments. The Washington Charter defines principles, objectives, methods and instruments for the conservation of historic towns and urban areas [40].

In the principles and objectives of ‘The Washington Charter’; the conservation of historic towns should be integrated with economic and social development policies, the conservation of historic towns should be also integrated with urban and regional planning at every level, the importance of the participation of the residents for the success of the conservation studies are mentioned [40].

For the planning and conservation of historic towns, multidisciplinary studies should be done. Conservation plan must address all relevant factors, must contain clearly stated objectives and should be supported by the residents. Moreover, existing conditions in the area should be documented, new functions and activities should be compatible with the character of the historic town and historic towns should be protected against natural disasters [40].

2.1.1.2 Burra Charter

‘The Burra Charter’, also known as ”*The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance*”, was first drafted in 1979 by the ICOMOS Australian National Committee and the finalized has emerged after revisions made in 1981, 1988 and 1999 [9].

‘The Burra Charter’ is an important document that aims to provide guidance on the conservation and management of places of cultural significance. ‘The Burra Charter’ is prepared specifically for Australia, later accepted by all around the world because of the principles, processes, methods and tools stated in the charter and it has become one of the main documents [9].

‘The Burra Charter’ is an important guidance which sets standard of practice for actors and decision makers including managers, property owners, and etc. for the conservation and management of cultural and historical places [41].

The Burra Charter Process

Sequence of investigations, decisions and actions

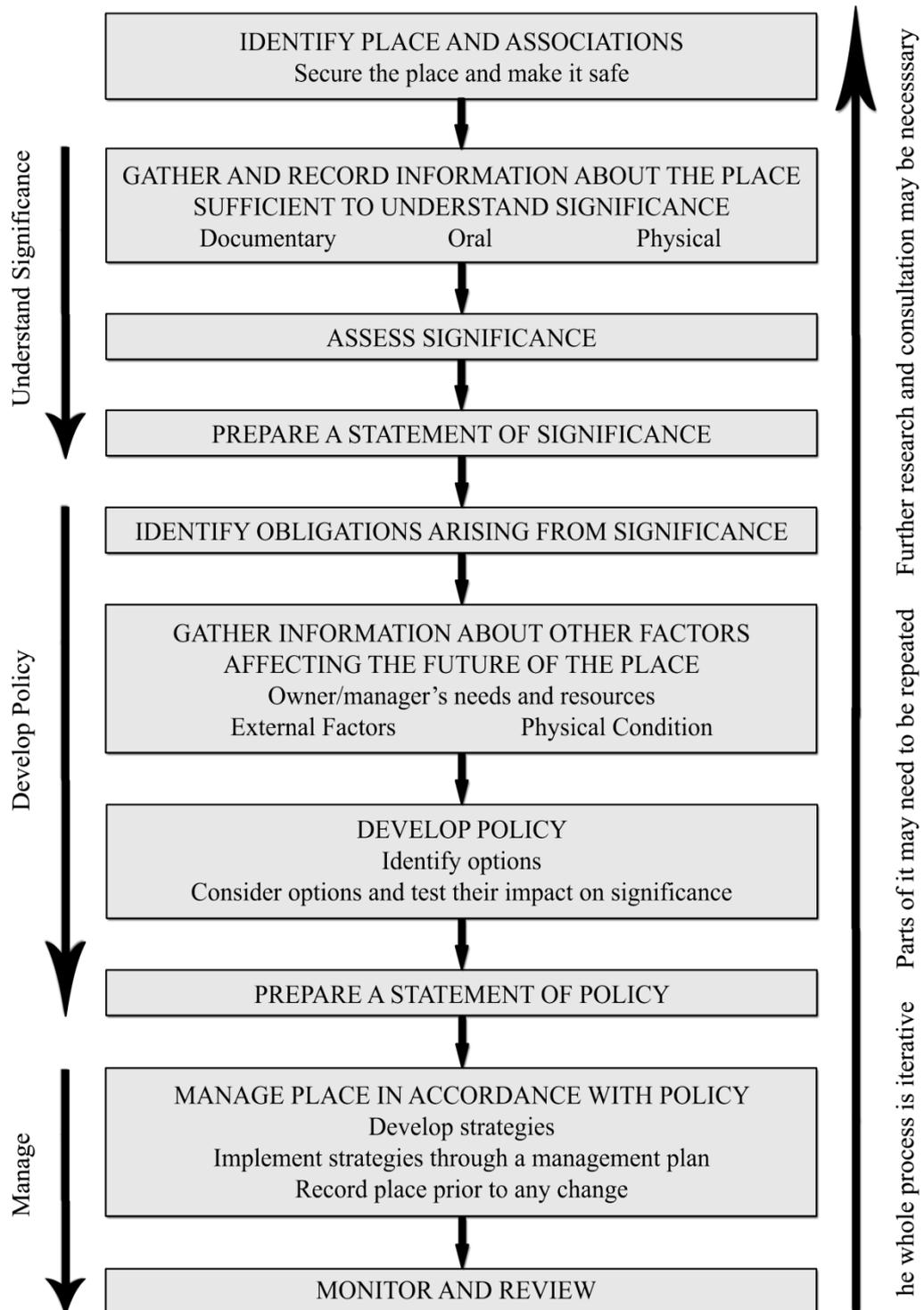


Figure 2.1: The Burra Charter Process (The Burra Charter, 1999 - Redrawn by the author, 2015).

As it mentioned in ‘The Burra Charter’, “Places of cultural significance should be conserved. At first, *understanding cultural significance* is important, then *development of policies* process comes and finally *management of the place* as required in the policies. Conservation is an integral part of the good management of cultural significance places”. According to ‘The Burra Charter’; the best way of understanding cultural significance and issues that will affect its future is done by collecting and analysing information before making decisions [41].

2.1.1.3 The Valletta Principles

‘The Valetta Principles’, produced as the end result of the General Assembly of ICOMOS held in Valetta in 2011, is the most recent international document which defines the main principles of urban conservation.

The main objective of the ‘Valletta Principles’ is to propose principles and strategies for defining interventions about conservation of historic towns. These principles and strategies aim to preserve the values of historic towns and their relation with social, cultural and economic life [42].

At first, related definitions such as historic towns and urban areas, safeguarding, protected urban area, management plan, etc. are described briefly. Then, aspects of change such as change and the natural environment, change and the built environment, change in use and social environment, etc. are mentioned. After that, intervention criteria about method and scientific discipline, multi-disciplinarity and cooperation, cultural diversity, etc. are described one by one. At the end, proposals and strategies on various subjects such as elements to be preserved, participation, conservation plan, management plan, etc. are stated [42].

According to ‘The Valletta Principles’, historic towns as living organisms are the living evidence of the past. The conservation of historic towns can be achieved primarily by planning. A conservation plan must be based on urban planning for the whole town and must be a participatory process involving all stakeholders. Moreover, conservation plan should be combined with a management plan [42].

2.1.2 Actors & Stakeholders in Decision Making Process

Participation of different actors in decision-making process is necessary for producing more accurate decisions. Participants in the decision-making process can be considered in two main groups.

First group is the decision-makers group. *Municipalities* are one of the decision-maker participants of the urban conservation process. Municipalities are authorized institutions for preparing development plans. *Conservation Councils of Cultural Properties* are the other decision-maker, controller and approver participant of the urban conservation process. Conservation Councils assist Municipalities for making decisions and preparing conservation plans, controls given decisions and approves conservation plans [38].

Citizens, related chambers and universities are the other group of participants of the urban conservation process. Planning decisions are given also with the participation of related chambers, civil society organizations, relevant departments of the Universities and the citizens living within the conservation area. Decision-makers get their opinion about decisions [38].

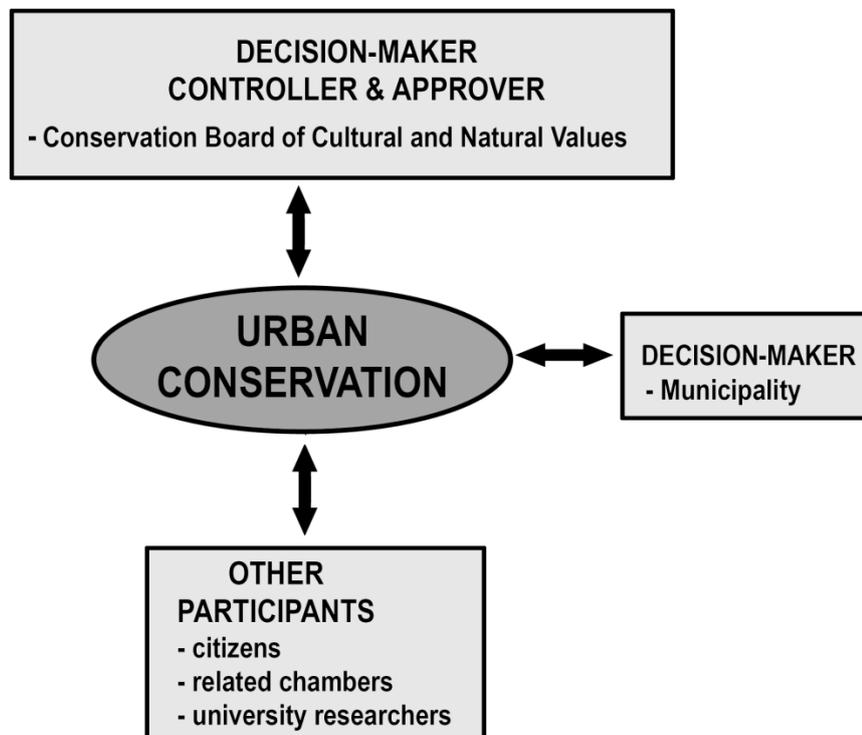


Figure 2.2: Stakeholders of Urban Conservation.

The duties of Municipalities about urban conservation are [38];

- collecting data from the field about historic buildings and social status of households,
- analyzing collected data and obtaining information,
- making decision about historical settlement and the surroundings
- preparing conservation aimed development plans according to collected information and their analysis,
- making new revisions or preparing revision development plans periodically,
- informing citizens, and helping citizens about their duties in conservation studies,

The duties of Conservation Council of Cultural Properties about urban conservation are [38];

- making the registration of cultural and natural assets to be conserved,
- grouping cultural and natural assets to be conserved,
- determining the structure conditions of transitional period within three months from the registration of conserved areas,
- examining conservation aimed development plans and changes in time, and taking decisions,
- determining conserved areas of cultural and natural assets to be conserved,
- unregistering the registered immovable cultural properties to be conserved which have lost characteristics,
- taking decisions for cultural and natural assets to be protected and conservation areas with related manner of usage.

Citizens, related chambers, civil society organizations and relevant departments of universities are the other participants. Citizens should participate in the decision-making process of the conservation studies of their living area. They should follow the decision given. According to the decision given, citizens may contest the decisions given or make new requests [38].

2.2. GIS and Web-Based GIS Technologies

The National Centre of Geographic Information and Analysis (NCGIA) define GIS as “a system which contains hardware, software and procedures to facilitate the management, manipulation, analysis, modelling, representation and display of georeferenced data”. GIS uses these abilities to solve complex problems associated with planning and management of data sources [33].

GIS can perform complicated analytical functions and then present the results visually as maps, tables or graphs. Moreover, GIS allows for combining information at different layers, analysing and studying them in relation to each other [33].

GIS is used for building systems which have many capabilities such as handling spatially distributed data, relating them to other numerical or descriptive data, and presenting the data visually on a map [7] [11].

As Longley et al. [22] stated, when GIS applications first came out, everyone was working separately on their personal computers with expensive commercial software programs. However, this situation began to change after 1990s. As a result of the rapid growth in computer technology, data sharing between GIS users became widespread.

Internet is an open source computer-based communication technology and has become a powerful tool that can be accessed throughout the world. Internet has enabled availability and easy accessibility of web-based applications and widespread usage of web-based applications. Thus, accessibility of web-based applications will be not only between individual users but also between governmental and administrative authorities [22].

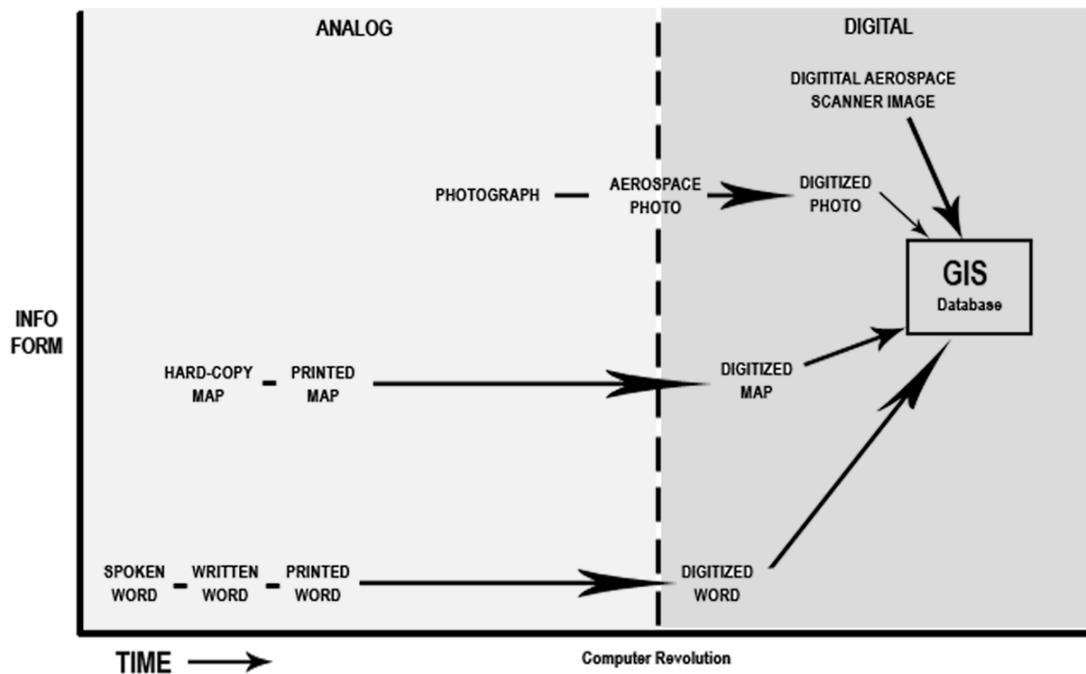


Figure 2.3: Forms of Geographical Information through time and their integration in a GIS database (Source: King, 1991:66 - Redrawn by the author, 2015).

Peng and Tsou [27] categorized GIS technologies into three categories taking into consideration of change and development in technologies over time. First category is the ‘Mainframe GIS’ which is adopted as monolithic computing model and contains all the programs in the same computer. Second one is the ‘Desktop GIS’ which uses GIS programs embedded in desktop computers. There are two different application styles in ‘Desktop GIS’. In stand-alone desktop GIS functions and data operations, there is only one stand-alone computer and no data transfer with the others. On the other hand, in LAN-based desktop GIS application, there is a network communication with the servers inside an official LAN. GIS programs have to be installed on every different computer in the network. More people can use the features of GIS on desktop applications, but still limited numbers of people can access the information. Only connected desktop computers and users inside LAN can access the information. Last category is the distributed GIS, which has the capability of distributing GIS features to many users and contains a relatively new approach ‘Internet GIS’. Unlike the others, ‘Internet GIS’ provides more flexible, dynamic and simpler applications without constraints of computer hardware and operating systems [27].

Table 2.1: Comparisons of Desktop GIS and Distributed GIS (Source: Peng & Tsou, 2003:8, Redrawn by the author, 2015).

Application Characteristics	Mainframe GIS	Desktop GIS	Distributed GIS	
			Internet GIS	Mobile GIS
Architectural Models	<i>Monolithic</i>	<i>Ethernet Era Client/Server (two-tier)</i>	<i>Web Client/server (three tier or n tier)</i>	<i>Wireless Client/server (three tier or n tier)</i>
Client	<i>Dumb Terminals</i>	<i>Desktop Computers</i>	<i>Web Client</i>	<i>Wireless devices</i>
Client Interface	--	<i>Fat Graphic User Interface (GUI) Clients</i>	<i>Web browser, Java Beans, Active X Controls</i>	<i>Mini browser, Wireless Application Protocol (WAP)</i>
Networks	<i>Local Area Networks</i>	<i>LANs or Wide Area Networks (WANs)</i>	<i>The Internet</i>	<i>Wireless Networks and the Internet</i>
Server	<i>Mainframe</i>	<i>Application Servers and Data Servers</i>	<i>Web Servers, Application Server, GIS Server and Data Servers</i>	<i>Gateway Server, Web Server and GIS Servers</i>
Number of Accessible Servers	<i>One</i>	<i>One or limited few</i>	<i>Thousands or more</i>	<i>Thousands or more</i>

Desktop applications have several limitations compared to Internet GIS. Internet GIS technology has emerged to overcome these limitations of desktop GIS software [26]:

- every user has to buy a desktop GIS software package and has to know how to use that software.
- investment for the GIS software program is not possible for every user
- the inaccessibility to desktop GIS from every place
- it is very difficult and expensive to buy a new one if the user decides to change the GIS technology and the software package in use.

Web-based GIS uses the Internet to access data, carry out spatial analysis and provide location-based services in an easier and faster way. Advantages over desktop GIS are mentioned by Peng and Tsou [27] as accessibility to geospatial data all around the world at any time, simple and user-friendly web interface applications.

GIS facilitates the management, manipulation, analysis, modelling, representation and display of geospatial data. On the other hand, Web-GIS provide a way for utilizing these web-based geographic data. Moreover, with an increase on internet usage, technology to share GIS data is also changed. Web GIS and Open GIS usage on the internet is rapidly increasing [33].

The web-based GIS provide basic GIS functions to users such as pan, zoom and turning data layers on and off. Web-based GIS also has additional abilities such as querying and viewing attribute data linked to objects displayed on the map [13].

2.2.1. Web-Based GIS Architectures

After the development of Internet and GIS technologies, several new techniques such as client-side and server-side have been improved. In these new techniques, different programming languages have been used to implement web-based mapping applications. Client invokes an operation from the server. Server-side has the data storage and all of the functions processing performed in there. When a client browses or queries the map, requests are sent to the server-side [34].

2.2.1.1 Server-side Technique

Each of the web-based GIS programs has its software design architecture and associated with specific database structures. This situation may obstruct interoperability and data sharing through different systems. However, all versions and types of browsers are supported by server-based applications. They are thought to be most convenient online GIS applications [25].

In server-based architecture, there is no need to install any additional resources on the clients' machine. Request of the users are sent directly on the GIS servers (map servers). On the other hand, Peng and Tsou [27] mentions that, server-side architecture has also problematic features such as created high volumes of network traffic by performing every request on the server side. After number of requests increase and network traffic becomes higher, server become unable to cope these large volumes of operation tasks coming from users. The most important feature of server-side architecture is that, clients only retrieve maps and display some results in HTML format; so a powerful client machine isn't needed [25].

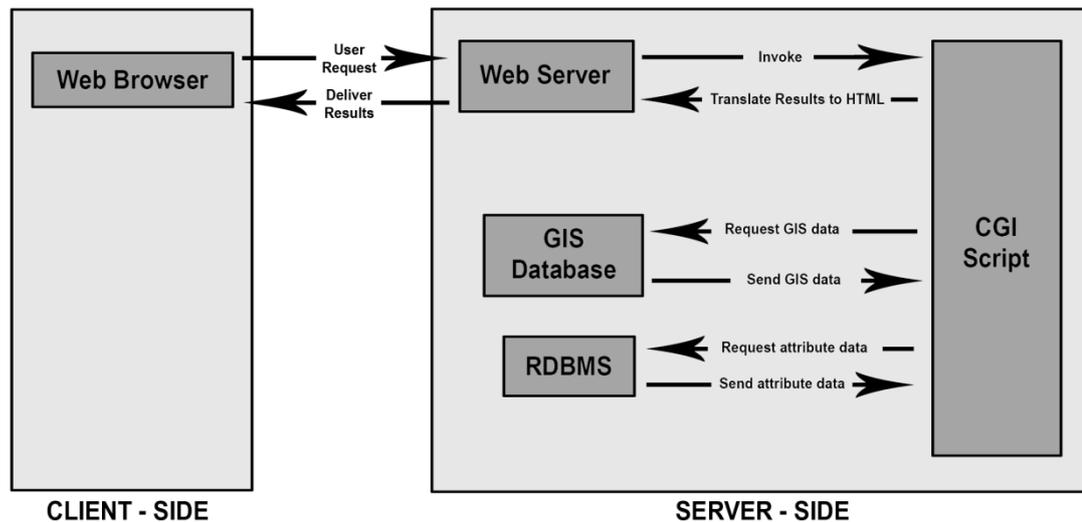


Figure 2.4: Server-based architecture (Source: Prastacos & Kotzinos, 2001:597 - Redrawn by the author, 2015).

Server-side architecture contains three main components; the web server, application server and database server. Web server processes the requests coming from the client and delivers the results back to the client. In server-side architecture, scripting languages like PHP and ASP help the web server for creating dynamic web pages. Database servers host database services, which store both spatial and non-spatial data, within computers or programs. Database servers also provide data access through some querying languages, such as Structural Query Language (SQL) [34].

2.2.1.2 Client-side Technique

As Prastacos [29] mentioned, in client-side architecture not all the tasks are performed on the server-side; some of the data processing operations are performed on the clients' computer. Therefore, there are fewer request loads on the server and less network traffic on the web [25].

Users install some extension components to the web browser to increase user interactivity. This components or programs work within the browser and provides the capability of making more advanced GIS analysis. With the usage of these components or programs, client-side architecture provides more dynamic operations and sends vector data to the users. Vector data has more advantages in comparison to raster image data. After installing and using these additional components or programs, visualization quality of spatial queries on the map becomes better and faster on the browser [25].

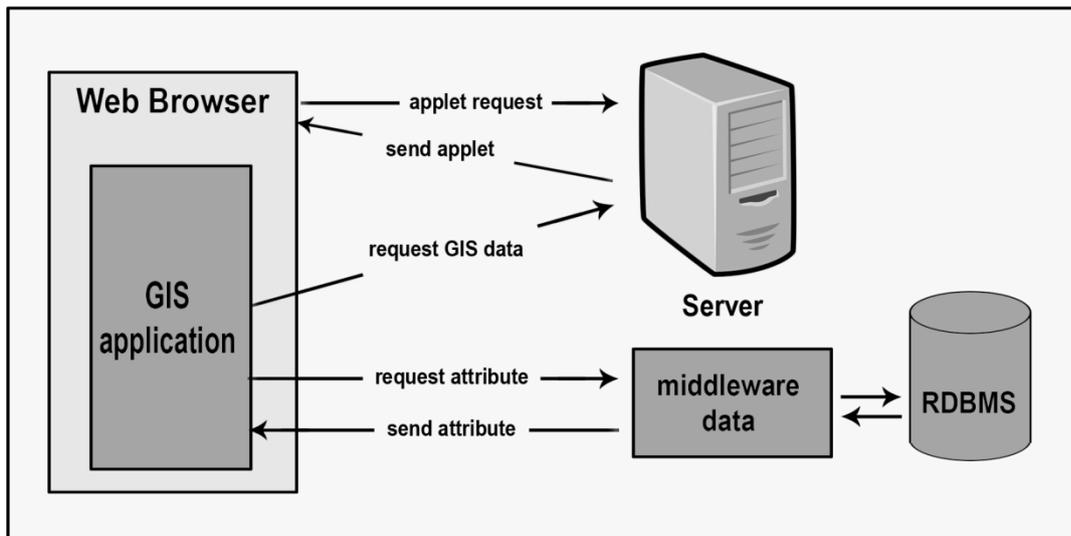


Figure 2.5 Sequence of operations in a client-side application (Source: Prastacos, 2000:14 - Redrawn by the author, 2015).

Java applets are designed for providing interactive features to web applications that cannot be provided by HTML. Java Applets do not need any software installation. They can be downloaded to the user's computer. When the users' machine connects to the internet, user starts to working with a Java-enabled web browser. Java Applets run into the browser's memory space, and stop working, and they are unloaded when the connection is cut off [25].

Thick-client has more interactivity capabilities on the client-side. In thick-client strategy, some GIS capabilities can be downloaded and processed locally on user's computer. If the same requests are done before and data are previously downloaded on the same local computer, there will be no need to send requests to the server again [34].

On the other hand, in client-side architecture, user should have powerful computers and fast network connection to use it. Downloading and processing large amounts of data may cause Internet traffic problems and increase download time, to avoid this also a more sophisticated hardware configuration is needed [34].

2.2.2. Components of Web-based GIS

Web-based GIS has an important influence on the rapid changes in Information Technology. Technological tools such as computers, scanners, software programs, used in GIS environment are also affected from developments in computerized technology. In that respect, internet usage has become a bigger and important part of information technology and internet is also widely used in GIS applications [25].

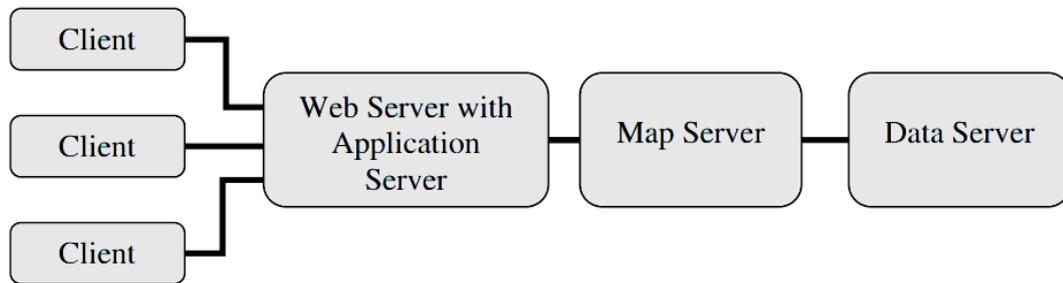


Figure 2.6 Components of web-based GIS (Source: Peng & Tsou, 2003:20 - Redrawn by the author, 2015).

Web-based GIS technology includes four main components such as Web Server with Application Server, Map Server, Data Server and Client. Requests sent to the web server, have a link to a web-based GIS application. At first, parameters of the query are transferred to a GIS engine and then the GIS software executes the query. Afterwards, the result is summarized into a single image and delivered to users as a result page on the web interface [25].

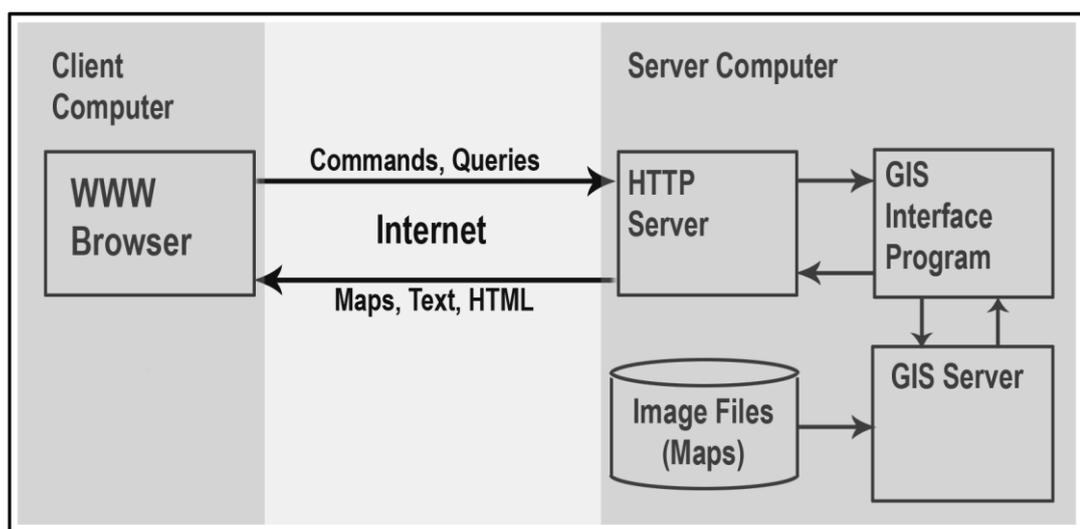


Figure 2.7 Architecture of dynamic configuration (Source: Plewe, 1997:85 - Redrawn by the author, 2015).

2.2.2.1. Web Server with Application Server

Web server is one of the major components of web-based GIS. HTTP (Hypertext Transfer Protocol) is a web server which receives client requests from web browsers. One of the most common ways to respond user requests from web browsers is sending HTML documents. HTML is a mark-up language which is used to indicate the structure of text-based information on a web browser. With HTML, the text elements can be displayed in the forms like links, headings, paragraphs, lists and they can be also supported with the embedded images or tables [25].

On the other hand, features of HTML are not enough to represent spatial features such as point, line or a polygon. HTML provides static representation. It is presented on the web, and the user cannot change it. In other words, users cannot manage web-based GIS depending on HTML and HTTP alone and users can not draw an object directly on the web browser [28].

Some client-side applications and components like plug-ins, Active-X controls, and Java applets have been developed in order to cope with the limitations of the HTML and HTTP. In order to display a geographic location or to process spatial data (to define the boundaries of an area or to measure the distance between two different location points), lines or polylines can be drawn by using these applications. The result of the process can be visualized on static or interactive maps [25].

2.2.2.2. Map Server

Map server is another major component of web-based GIS. Map server generates static or interactive maps on the web browsers. Map server has the capability of displaying requested information on the maps and with this capability it provides spatial queries. Recently developed map servers have many capabilities of basic GIS functions such as zooming, panning, drawing point, line or polygon. Moreover, they also have some advanced GIS features such as inserting attribute tables or graphics [25].

2.2.2.3. Data Server

Data server is the third major component of web-based GIS. Data server contains spatial and non-spatial data in a relational database and provides processes of the

relational databases. A web user or a map server can access and query to the database by using SQL statements. Thus, a data server is usually called as SQL server [27]. SQL is a programming language which is developed for querying and modifying data and managing databases. SQL has a command language structure. With commands, users can perform many functions such as the retrieval, insertion, updating, and deletion of data in a database [25].

2.2.2.4. Client

Client is the last major component of web-based GIS. Client is defined as a place for users, where the users used to support interaction with mapping and processing geospatial data with GIS functionality on the web. Peng and Tsou [27] define client “as a place for web-based GIS programs to display outputs to the users”. A typical web interface with HTML forms can be thought as a simple client application for web-based GIS. For the visualization of outputs of web-based GIS applications, different instruments like a desktop computer or a mobile phone can be used [25].

2.2.3. Software and Technologies for Web-Based GIS

Unlike other well paid programs, open source software give freedom to users to use the program without limitations or payments. Users can use open source programs for any purpose, modify the program and freely redistribute modified program. There are many open source software available to develop a web based GIS.

The following software programs or similar programs were recommended for Web-based GIS application development.

2.2.3.1. ArcGIS (ArcMap)

ArcGIS is a collection of software products that includes desktop, server, mobile and online GIS products. The desktop GIS products allow users to integrate and edit data; create new map layers [43].

ArcGIS is primarily used as a single-user mapping and analysis tool. Users create and interact with maps using ArcMap. In other words, geographic data can be viewed, edited, and analysed. With ArcMap followings can be done [43]:

- query spatial data to find and understand relationships among geographic features,
- symbolize data in a wide variety of ways,
- create charts and reports, lay out maps,
- create maps that integrate data in a wide variety of formats.

2.2.3.2. MS Access

Microsoft Access is a database management system that integrates the relational database engine with a user interface and software-development tools. Microsoft Access stores data in its format that based on the Access Jet Database Engine. Microsoft Access can both import data stored in other applications (databases) and export to other databases [44].

2.2.3.3. PostGIS & PostgreSQL

Except for general-purpose databases, there are also spatial databases occurred as an extension of databases that provide spatial indexing and support spatial queries. Spatial databases with features of spatial indexing and querying, improve performance for geospatial applications. Because of the capabilities for supporting spatial features, PostgreSQL with PostGIS extension as an open source database began to be used more widely for the spatial database [37].

PostgreSQL is a powerful object-relational database system as an open source database. It runs on all major operating systems. PostgreSQL supports all the database elements like foreign keys, joins, triggers and stored procedures in multiple languages. PostgreSQL also includes most SQL92 and SQL99 data types. Moreover, PostgreSQL supports storage of binary large objects [37].

On the other hand, PostGIS is a supporting project for geographic objects in PostgreSQL. PostGIS allows PostgreSQL to be used as a spatial database for GIS. It implements the OGC standards like ‘Simple Features Specification for SQL’ for spatial extensions to the SQL language. Furthermore, it is widely supported by other GIS software [37].

2.2.3.4. Geoserver

Geoserver is an open source software server where users can share and edit geospatial data. It is written in Java and designed for interoperability. With the GeoServer, any major spatial data source can be published. GeoServer is proper to WFS, WCS and WMS standards of OGC. GeoServer is a high performance certified compliant WMS software server. Except the capability of publishing spatial data, GeoServer also supports the most of GIS functions [37].

2.2.3.5. JavaScript libraries

A JavaScript library is a pre-written JavaScript library that allows for easier development of JavaScript-based applications. With the technological developments in computing, JavaScript is started to widely used for developing user interfaces for both web-based and desktop-based applications. By combining JavaScript with CSS, dynamic web pages can be created. Many JavaScript libraries have been developed for GIS nowadays [37].

2.2.3.6. Open Layers & JQuery

OpenLayers is an open source JavaScript library for displaying map data in web browsers. It provides an API for building rich web-based geographic applications similar to Google Maps and Bing Maps. OpenLayers supports mark-up languages (such as KML and GML) and map data from any source that uses OGC-standards as WMS or WFS [45].

Thanks to OpenLayers, it has become easier to put dynamic maps in any web page. OpenLayers has been developed to improve advanced use of geographic information of all kinds, and it is completely free, open source JavaScript library [46].

Features of OpenLayers;

- supports various data sources,
- supports displaying geographic features,
- easy to configure and into other applications,
- allows full control over OpenLayers powered map.

JQuery is a fast, small, and feature-rich cross-platform JavaScript library that designed to simplify the client-side scripting of HTML, and it is free, open source software." JQuery is today's one of the most popular JavaScript library [56].

2.2.3.7. MS Visual Studio

MS Visual Studio is 'an integrated development environment (IDE)' which is used to develop console and user interface applications, web sites, web applications and web services for all platforms (supported by Microsoft Windows, Windows Mobile, .NET Framework and Microsoft Silverlight) [47].

Visual Studio supports different programming languages such as C/C++, VB.NET, C#, and F#, and allows the code editor and debugger to support nearly any programming language. Visual Studio also supports M, Python, and Ruby as other languages and XML/XSLT, HTML/XHTML, JavaScript and CSS [47].

Visual Studio tools that aim to develop applications include [47]:

- Windows Forms Designer
- WPF Designer
- Web designer/development (website editor and designer, used for developing ASP.NET applications, supports HTML, CSS and JavaScript)
- Class designer
- Data designer
- Mapping designer

2.2.3.8. HTML & CSS

HTML is the primary mark-up language that used for creating web pages and forming the each part of all websites. It can display different kinds of information in a web browser and be used to create interactive forms. It can set scripts written in languages (such as JavaScript) that affect the behaviour of HTML webpages [48].

HTML contains processing models that encourage to more interoperable applications. It extends, improves mark-up documents, and introduces mark-up and APIs for complex web applications. Characteristics of every item in HTML mark-up are defined in the browser, and they can be altered by using CSS additionally [48].

CSS is 'a style sheet language' that used for describing and formatting of a document written in a mark-up language. CSS most commonly used to style web pages written in HTML. Furthermore, it can be applied to any XML document [49].

CSS is designed primarily to enable document presentation including visual elements like the layout, colours, size, borders, fonts and many other typographic characteristics. CSS usage can improve content accessibility, provide more flexibility and control over presentation characteristics, share formatting for use in multiple pages, and reduce complexity and repetition. CSS can also be used to allow displaying of the web page on different screen sizes or devices [49].

2.2.3.9. IIS (Internet Information Services)

Internet Information Services (IIS) is a web server that supports transfer protocols such as HTTP, HTTPS, FTP, FTPS, SMTP and NNTP. An IIS application uses HTML to exhibit its user interface. IIS is running on a Web server and uses Visual Basic code to process requests from the browser and responds to requests in the browser. Building a server-side Internet application with IIS gives several advantages compared to other methods of Internet development, such as [50] [51];

- reduced cost of deployment per user,
- a known development environment and model,
- access to a wide audience,
- direct access to the resources,
- reusable components,
- separation of code and HTML,
- streamlined processing.

2.2.3.10. Google Maps API

Google Maps API is developed for developers to allow integration of Google Maps into websites as a free service [52].

Initially, Google Maps API is designed as a JavaScript API. And then, Maps API abilities are improved, and it is started to use as a web services for retrieving static maps, performing geocoding and obtaining elevation profiles. Nowadays, over one million websites use Google Maps API [52].

2.2.4. Open Specifications for Web- based GIS (OGC)

In order to be able to ensuring interoperability between data collected from different sources, integrating and sharing geographical data, the Open Geospatial Consortium (OGC) has set standards for the Web-GIS services. OGC is an international consortium which defines standards to provide interoperable solutions. It has a variety of contributors from different areas such as private industry and academia which are contributing to creating open and extensible software application programming interfaces for GIS. Several standards are presented about the web services utilized for transferring geospatial data over Web. There are three main types of web services, which are utilized for transferring geospatial data over Web. These are WFS, WCS and WMS [36].

Web Feature Service (WFS) is a new way of creating, modifying and exchanging geographic information on Internet. Moreover, WFS allows accessing to geographic information at the feature property level, and allow clients to only retrieve or modify the data they are looking for, not the whole data [53].

Web Map Service (WMS) is a new way of producing maps of spatially referenced data using geographic information. OGC defines WMS standards. In WMS standards, these maps are defined as portrayal of geographic information and image files suitable for display on computers such as PNG, GIF or JPEG picture formats, not the data itself [54].

Web Coverage Service (WCS) supports retrieval of ‘coverages’ that means digital geospatial information representing space/time-varying phenomena electronically in forms that are useful for client-side rendering [55].

2.3. Web-Based GIS in Urban Conservation

As Özyer [25] mentioned, through the storing, displaying the various kinds of data and sharing with other users characteristics, Web-based GIS has been known as the most powerful and functional tool for improve information portal. Main goal of the usage of GIS and Web-based GIS tools is integration of various data together with documentation of all information related with conserved areas and buildings [25].

Cultural heritage documentation is the collection of information needed to know about all tangible and intangible aspects of the heritage places. Before restoration, conservation and management, documentation is important. Documentation is also important in terms of sharing knowledge and transferring information to the future [30].

Public administrations have to make decisions and generate policies. It's very important to collect a great variety of information and construct database for dealing with conservation problems of the heritage and making decisions. The experts from different disciplines such as history, archeology, architecture, engineering, cultural anthropology and etc., have to carry out their own researches and analyses. After researches and analysis made, the next step is to integrate all these data in one efficient tool [30].

Rinaudo et al. [30] were trying to find an independent way to deliver data to people from where they are. They decided that internet is the best answer. According to them, people from every part of the world can reach to data in an easy way and an incredible number of people can access. This solution is economical and simple. People can access the data shared by WebGIS by using any of the hardware and software with elementary computer knowledge and connecting to the internet [30].

2.4. Discussion

Historic towns are important for transmission of the historical heritage to future generations and cultural continuity. They should be conserved. Urban conservation is a participatory decision-making process. It is important to be participatory for making better and more accurate decisions.

At the end of the decision-making process, conservation plans are prepared as mentioned in the laws and regulations. Conservation plans are prepared for managing the conservation process, solving the problems and identifying/developing the strategies after examining all the characteristics of the historic environment. Municipalities prepare conservation plans, but conservation boards are the approval mechanism of the conservation plans. Decision-making and conservation plan preparation processes are specified in charters (e.g. The Washington Charter, The Burra Charter, etc.) and principles.

GIS applications are successful in spatial and non-spatial data management, analysis and storage issues. With the development of technology and spread of the internet network, Web-based GIS technology is emerged and provides several conveniences. Web-based GIS has become an information system that easily accessible from anywhere in the world and data sharing has become cheap, easy and quick.

After development of technology, several new techniques/architectures improved for Web-based GIS applications such as server-side and client-side techniques. Both techniques have successful and weak characteristics, but server-side architecture which is more user-friendly is more preferable.

Web-based GIS technology includes four main components such as Web Server with Application Server, Map Server, Data Server and Client. The client makes a request to a server. Whenever a user submits a request, the server processes the request and returns the information to the client. There are many software and programs including open source software, available to develop a web based GIS. In order to be able to ensuring interoperability between data collected from a different source, Open Geospatial Consortium which is an international consortium has set standards for the Web-GIS services such as WFS, WMS and WCS.

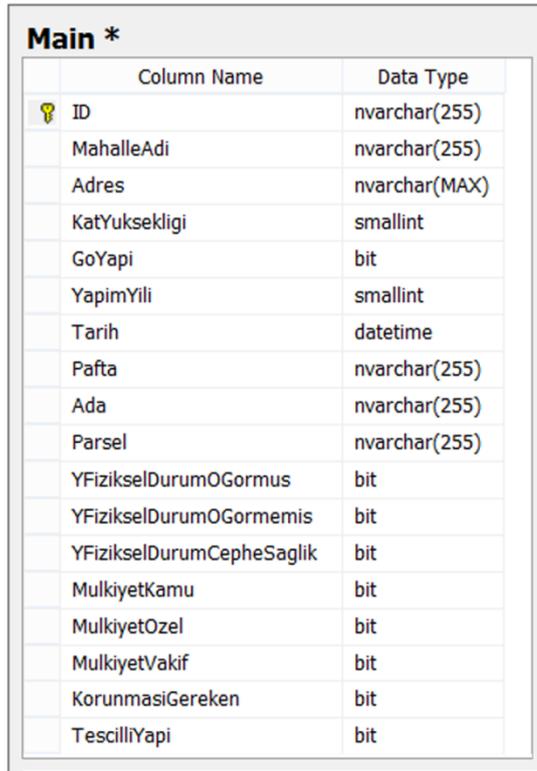
As mentioned before, through the storing, displaying the various kinds of data and sharing with other users characteristics, Web-based GIS has been known as the most powerful and functional tool for improve information portal.

CHAPTER 3

AN IMPROVED DATABASE DESIGN AND EXPERIMENTAL MEASUREMENTS

3.1 Database Design

Original database had been designed in the framework of CDP and it was obtained from Odunpazarı Municipality as an 1103 kb file sized MS Access database file. It is a single table database. It has nearly one hundred columns and most of them are unnecessary (Figure 3.1). Columns have a wide variety of data types such as text (nvarchar, 255), bit (true/false), number (integer), attachment, etc. Most of the columns have true/false bit data types instead of text type columns.



Column Name	Data Type
ID	nvarchar(255)
MahalleAdi	nvarchar(255)
Adres	nvarchar(MAX)
KatYuksekligi	smallint
GoYapi	bit
YapimYili	smallint
Tarih	datetime
Pafta	nvarchar(255)
Ada	nvarchar(255)
Parsel	nvarchar(255)
YFizikselDurumOGormus	bit
YFizikselDurumOGormemis	bit
YFizikselDurumCepheSaglik	bit
MulkiyetKamu	bit
MulkiyetOzel	bit
MulkiyetVakif	bit
KorunmasiGereken	bit
TescilliYapi	bit

Figure 3.1: MS Access Original database table structure taken from Odunpazarı Municipality database developed within CDP.

Moreover, text data type columns defined as nvarchar (255) whose character length is too high and this type is even used for date and numeric values (e.g. “Tarih”, ”Parsel”). Because of this unnecessary data type usage and having so many columns, database is very crowded. Original database has an unsuitable design for using in web-based application.

Original database was needed to be improved for better and faster database query performance and to be more useful for the web-based application. In the improvement process, database normalization process was done. Columns that related to the same feature and bit data type were brought into a single column with ID numbers. The numerical values can be queried faster than text or other data types. New multi-table database was designed with new tables which contain id numbers and their corresponding definitions (Figure 3.2). Moreover, central metric X and Y coordinates of the buildings were added into the designed database.

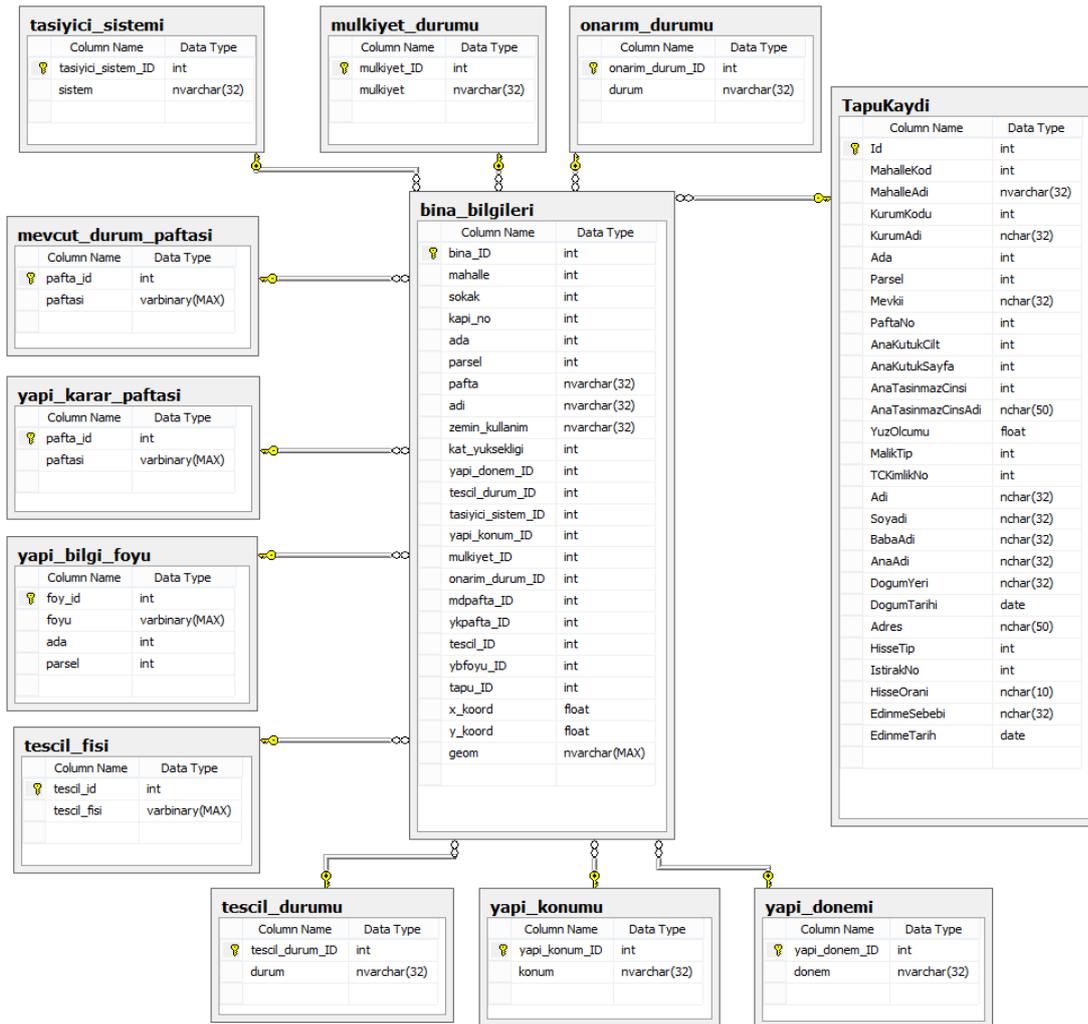


Figure 3.2: ER diagram of the new database structure designed for this thesis.



Figure 3.3: ER diagram of the new database structure designed for this thesis (Building information table with related property tables).

As it mentioned, structure feature tables have related ID numbers and their definitions (Figure 3.3). In the table below, newly designed tables and their contents are given (Table 3.1). These ID numbers are used in queries for better and faster query performance.

Table 3.1: Designed relational database tables with contents.

yapi_donem_ID	donem
1	1A
2	1B
3	1C
4	2A
5	2B
6	2C
7	3A
8	3B
9	3C
10	4A
11	4B
12	4C

tescil_durum_ID	durum
1	Korunması Gereken Nitelikli Yapı
2	Tescilli Yapı
3	Plan Kararlarına Göre Korunacak Yapı
4	Diğer

onarim_durum_ID	durum
1	Onarım Görmüş Yapı
2	Onarım Görmemiş Yapı
3	Cephe Sağıklaştırılması

tasiyici_sistem_ID	sistem
1	Ahşap Karkas
2	Yığma
3	Betonarme Karkas
4	Ahşap Karkas-Yığma

mulkiyet_ID	mulkiyet
1	Vakıf
2	Kamu
3	Özel

yapi_konum_ID	konum
1	Ayrık Nizam
2	Tek Taraftan Bitişik
3	İki taraftan Bitişik

In addition to building information table, land registry table (Figure 3.4) and related sheets (registration sheet, etc.) tables (Figure 3.5) were created. Relevant sheets were added into the designed database.

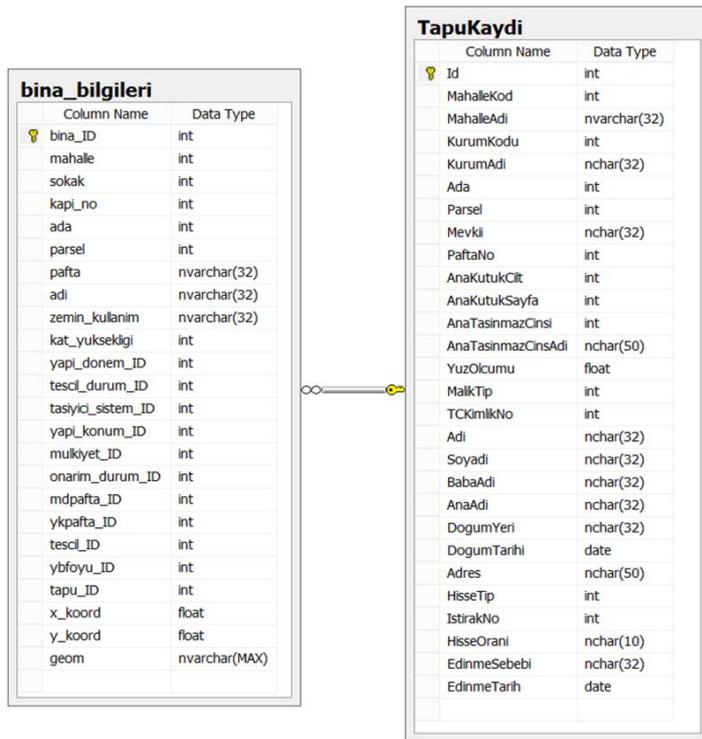


Figure 3.4: ER diagram of the new database structure designed for this thesis (relation between building information table and land register table).



Figure 3.5: ER diagram of the new database structure designed for this thesis (building information table with related sheets (registration sheet, etc.) tables).

The relation between the buildings and related sheets were established through id numbers. In brief, various kinds of related data were collected under a single database and their relations were defined.

3.2 Experimental Measurements and Results

Sample queries were chosen for performance measurements of the databases;

Original Database Query-1: Find and list all structures whose construction period is 1A (19th century and before &Rich) period.

```
SELECT *
FROM Main
WHERE Donem1a = 'TRUE' AND Donem1b = 'FALSE' AND Donem1c = 'FALSE'
AND Donem2a = 'FALSE' AND Donem2b = 'FALSE' AND Donem2c = 'FALSE'
AND Donem3a = 'FALSE' AND Donem3b = 'FALSE' AND Donem3c = 'FALSE'
AND Donem4a = 'FALSE' AND Donem4b = 'FALSE' AND Donem4c = 'FALSE'
```

Designed Database Query-1: Find and list all structures whose construction period is 1A (19th century and before &Rich) period.

```
SELECT *
FROM op_sit_binalar_polygons
WHERE yapi_donem_ID=1
```

Table 3.2: Performance measurement results of Query-1.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	1A Period Structures	116 ms	272 rows
	Designed Database	1A Period Structures	48 ms	
Size *2	Original Database	1A Period Structures	298 ms	544 rows
	Designed Database	1A Period Structures	57 ms	
Size *4	Original Database	1A Period Structures	739 ms	1088 rows
	Designed Database	1A Period Structures	74 ms	
Size *10	Original Database	1A Period Structures	1733 ms	2720 rows
	Designed Database	1A Period Structures	107 ms	

Original Database Query-2: Find and list all registered structures.

```
SELECT *
FROM Main
WHERE TescilliYapi = 'TRUE' AND KorunmasiGereken = 'FALSE' AND
PlanKGKYapi = 'FALSE' AND DigerYapilar = 'FALSE'
```

Designed Database Query-2: Find and list all registered structures.

```
SELECT *
FROM op_sit_binalar_polygons
WHERE tescil_durum_ID=2
```

Table 3.3: Performance measurement results of Query-2.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	Registered Structures	136 ms	314 rows
	Designed Database	Registered Structures	50 ms	
Size *2	Original Database	Registered Structures	259 ms	628 rows
	Designed Database	Registered Structures	62 ms	
Size *4	Original Database	Registered Structures	555 ms	1256 rows
	Designed Database	Registered Structures	77 ms	
Size *10	Original Database	Registered Structures	1464 ms	3140 rows
	Designed Database	Registered Structures	116 ms	

Original Database Query-3: Find and list all private property structures.

```
SELECT *
FROM Main
WHERE MulkiyetOzel = 'TRUE' AND MulkiyetKamu = 'FALSE' AND
MulkiyetVakif = 'FALSE'
```

Designed Database Query-3: Find and list all private property structures.

```
SELECT *
FROM op_sit_binalar_polygons
WHERE mulkiyet_ID=3
```

Table 3.4: Performance measurement results of Query-3.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	Private Property Structures	1044 ms	2213 rows
	Designed Database	Private Property Structures	284 ms	
Size *2	Original Database	Private Property Structures	2654 ms	4426 rows
	Designed Database	Private Property Structures	329 ms	
Size *4	Original Database	Private Property Structures	5247 ms	8852 rows
	Designed Database	Private Property Structures	382 ms	
Size *10	Original Database	Private Property Structures	12022 ms	22130 rows
	Designed Database	Private Property Structures	489 ms	

Original Database Query-4: Find and list all structures which were constructed with reinforced concrete.

```
SELECT *
FROM Main
WHERE BetonarmeKarkas = 'TRUE' AND AhsapKarkas = 'FALSE' AND Yigma =
'FALSE'
```

Designed Database Query-4: Find and list all structures which were constructed with reinforced concrete.

```
SELECT *
FROM op_sit_binalar_polygons
WHERE tasiyici_sistem_ID=3
```

Table 3.5: Performance measurement results of Query-4.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	Reinforced Concrete structures	122 ms	168 rows
	Designed Database	Reinforced Concrete structures	48 ms	
Size *2	Original Database	Reinforced Concrete structures	208 ms	336 rows
	Designed Database	Reinforced Concrete structures	52 ms	
Size *4	Original Database	Reinforced Concrete structures	432 ms	672 rows
	Designed Database	Reinforced Concrete structures	66 ms	
Size *10	Original Database	Reinforced Concrete structures	1044 ms	1680 rows
	Designed Database	Reinforced Concrete structures	94 ms	

Original Database Query-5: Find and list all repaired structures.

```
SELECT *  
FROM Main  
WHERE YFizikselDurumOGormus = 'TRUE' AND YFizikselDurumCepheSaglik =  
'FALSE' AND YFizikselDurumOGormemis = 'FALSE'
```

Designed Database Query-5: Find and list all repaired structures.

```
SELECT *  
FROM op_sit_binalar_polygons  
WHERE onarim_durum_ID=1
```

Table 3.6: Performance measurement results of Query-5.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	Repaired Structures	160 ms	278 rows
	Designed Database	Repaired Structures	54 ms	
Size *2	Original Database	Repaired Structures	264 ms	556 rows
	Designed Database	Repaired Structures	58 ms	
Size *4	Original Database	Repaired Structures	676 ms	1112 rows
	Designed Database	Repaired Structures	76 ms	
Size *10	Original Database	Repaired Structures	1690 ms	2780 rows
	Designed Database	Repaired Structures	111 ms	

Original Database Query-6: Find and list all structures which have adjacent structures on both sides.

```
SELECT *  
FROM Main  
WHERE YKnm_IkiTarafdanBitisik = 'TRUE' AND YKnm_TekTarafdanBitisik =  
'FALSE' AND Yknm_Anizam = 'FALSE'
```

Designed Database Query-6: Find and list all structures which have adjacent structures on both sides.

```
SELECT *  
FROM op_sit_binalar_polygons  
WHERE yapi_konum_ID=3
```

Table 3.7: Performance measurement results of Query-6.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	Structures Adjacent on Both Sides	362 ms	786 rows
	Designed Database	Structures Adjacent on Both Sides	104 ms	
Size *2	Original Database	Structures Adjacent on Both Sides	524 ms	1572 rows
	Designed Database	Structures Adjacent on Both Sides	127 ms	
Size *4	Original Database	Structures Adjacent on Both Sides	1181 ms	3144 rows
	Designed Database	Structures Adjacent on Both Sides	162 ms	
Size *10	Original Database	Structures Adjacent on Both Sides	2921 ms	7860 rows
	Designed Database	Structures Adjacent on Both Sides	226 ms	

Original Database Query-7: Find and list all non-repaired registered structures.

```
SELECT *
FROM Main
WHERE TescilliYapi = 'TRUE' AND KorunmasiGereken = 'FALSE' AND
PlanKGKYapi = 'FALSE' AND DigerYapilar = 'FALSE' AND
YFizikselDurumOGormus = 'FALSE' AND YFizikselDurumOGormemis = 'TRUE'
AND YFizikselDurumCepheSaglik = 'FALSE'
```

Designed Database Query-7: Find and list all non-repaired registered structures.

```
SELECT *
FROM op_sit_binalar_polygons
WHERE tescil_durum_ID=2 AND onarim_durum_ID=2
```

Table 3.8: Performance measurement results of Query-7.

		Query	Response Time (ms)	# of Returned Rows
Size 1	Original Database	Non Repaired Registered Structures	74 ms	129 rows
	Designed Database	Non Repaired Registered Structures	32 ms	
Size *2	Original Database	Non Repaired Registered Structures	187 ms	258 rows
	Designed Database	Non Repaired Registered Structures	38 ms	
Size *4	Original Database	Non Repaired Registered Structures	398 ms	516 rows
	Designed Database	Non Repaired Registered Structures	48 ms	
Size *10	Original Database	Non Repaired Registered Structures	886 ms	1290 rows
	Designed Database	Non Repaired Registered Structures	70 ms	

In the table below performance measurement results (response times) of the queries are given (Table 3.9). When the number of data (rows) increases, the query response time difference between two databases designs is also increasing.

Each query was performed ten-times and response times were measured. The measured response times in the tables were determined by taking the average of these measured response times of the repeated queries.

Table 3.9: Primary performance measurement results of Query1 - Query7.

Queries	Original Database	Designed Database	# of Returned Rows
	Response Time (ms)	Response Time (ms)	
<i>1A Period Structures</i>	116 ms	48 ms	272 rows
<i>Registered Structures</i>	136 ms	50 ms	314 rows
<i>Private Property Structures</i>	1044 ms	284 ms	2213 rows
<i>Reinforced Concrete structures</i>	122 ms	48 ms	168 rows
<i>Repaired Structures</i>	160 ms	54 ms	278 rows
<i>Structures Adjacent on Both Sides</i>	362 ms	104 ms	786 rows
<i>Non Repaired Registered Structures</i>	74 ms	32 ms	129 rows
	8,19 MB	7,16 MB	

In the second stage of the performance measurement, data amounts of the original and improved databases were doubled to measure the performance of the databases with larger data. The numbers of returned rows in the query result were also set to be doubled. In the table below secondary performance measurement results (response times) of the queries are given (Table 3.10).

Table 3.10: Secondary performance measurement results of Query1 - Query7.

Queries	Original Database	Designed Database	# of Returned Rows
	Response Time (ms)	Response Time (ms)	
<i>1A Period Structures</i>	298 ms	57 ms	544 rows
<i>Registered Structures</i>	259 ms	62 ms	628 rows
<i>Private Property Structures</i>	2654 ms	329 ms	4426 rows
<i>Reinforced Concrete structures</i>	208 ms	52 ms	336 rows
<i>Repaired Structures</i>	264 ms	58 ms	556 rows
<i>Structures Adjacent on Both Sides</i>	524 ms	127 ms	1572 rows
<i>Non Repaired Registered Structures</i>	187 ms	38 ms	258 rows
	10,24 MB	8,19 MB	

As expected, due to the databases were doubled, query response times increased. When the number of data (rows) increases, the query response time difference between two databases is also increasing. When the original database data was doubled, the query response times also become nearly two times of the values before.

In the next stages of the performance measurement, four times (Table 3.11) and ten times (Table 3.12) larger the data amounts of the original and improved databases were measured to compare the performances of the databases.

Table 3.11: Tertiary performance measurement results of Query1 - Query7.

Queries	Original Database	Designed Database	# of Returned Rows
	Response Time (ms)	Response Time (ms)	
<i>1A Period Structures</i>	739 ms	74 ms	1088 rows
<i>Registered Structures</i>	555 ms	77 ms	1256 rows
<i>Private Property Structures</i>	5247 ms	382 ms	8852 rows
<i>Reinforced Concrete structures</i>	432 ms	66 ms	672 rows
<i>Repaired Structures</i>	676 ms	76 ms	1112 rows
<i>Structures Adjacent on Both Sides</i>	1181 ms	162 ms	3144 rows
<i>Non Repaired Registered Structures</i>	398 ms	48 ms	516 rows
	15,36 MB	10,24 MB	

Table 3.12: Quaternary performance measurement results of Query1 - Query7.

Queries	Original Database	Designed Database	# of Returned Rows
	Response Time (ms)	Response Time (ms)	
<i>1A Period Structures</i>	1733 ms	107 ms	2720 rows
<i>Registered Structures</i>	1464 ms	116 ms	3140 rows
<i>Private Property Structures</i>	12022 ms	489 ms	22130 rows
<i>Reinforced Concrete structures</i>	1044 ms	94 ms	1680 rows
<i>Repaired Structures</i>	1690 ms	111 ms	2780 rows
<i>Structures Adjacent on Both Sides</i>	2921 ms	226 ms	7860 rows
<i>Non Repaired Registered Structures</i>	886 ms	70 ms	1290 rows
	28,67 MB	16,38 MB	

As it is seen in the tables, due to the size of the databases were increased, query response times were also increased in specific proportions. When the sizes of the databases are increased, the query response time differences between two databases also increases.

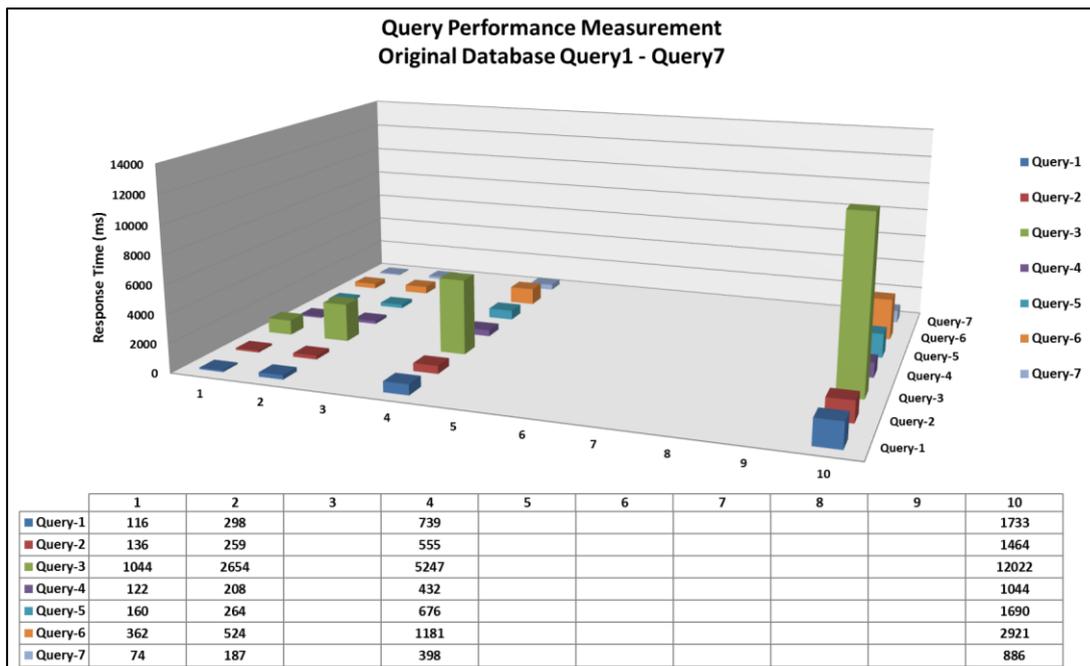


Figure 3.6: Original Database Query1-Query7 performance measurement results.

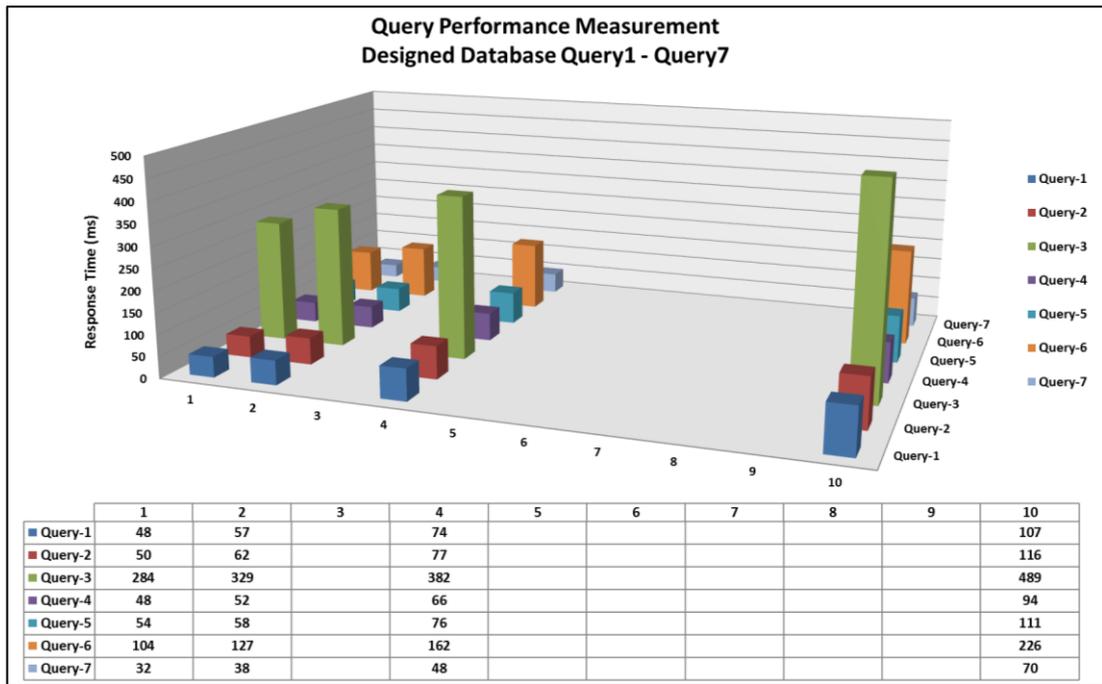


Figure 3.7: Designed Database Query1-Query7 performance measurement results.

As it is seen in the graphs, while increment in the data of the original database caused significant increase in the query response times, increment in the data of the designed database caused little increase in the query response times.

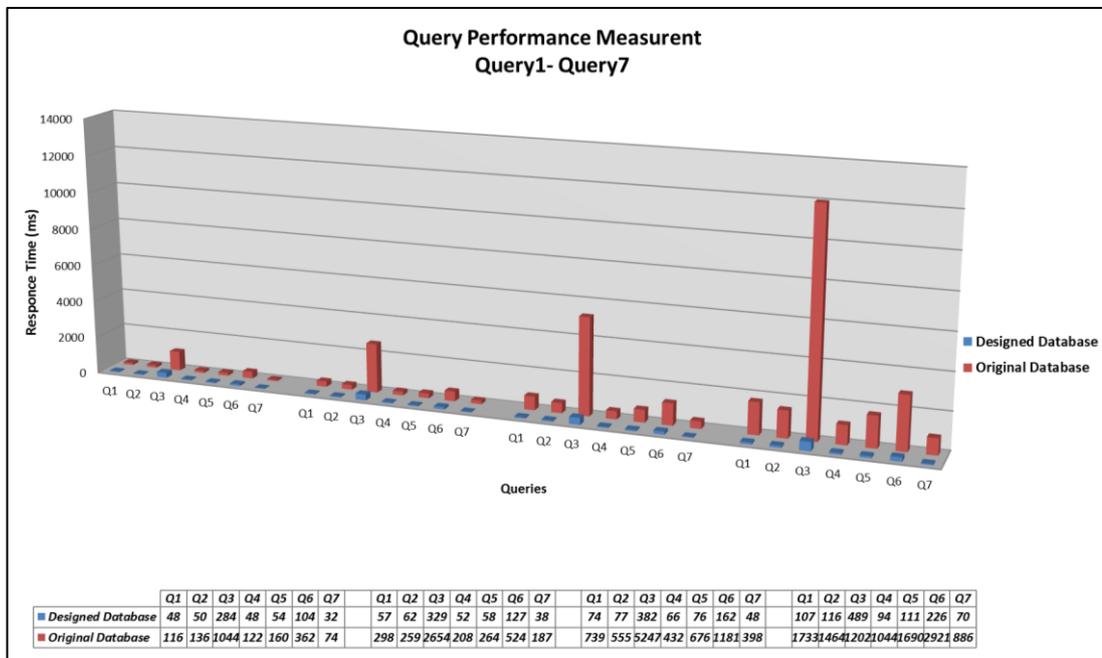


Figure 3.8: Performance measurement results.

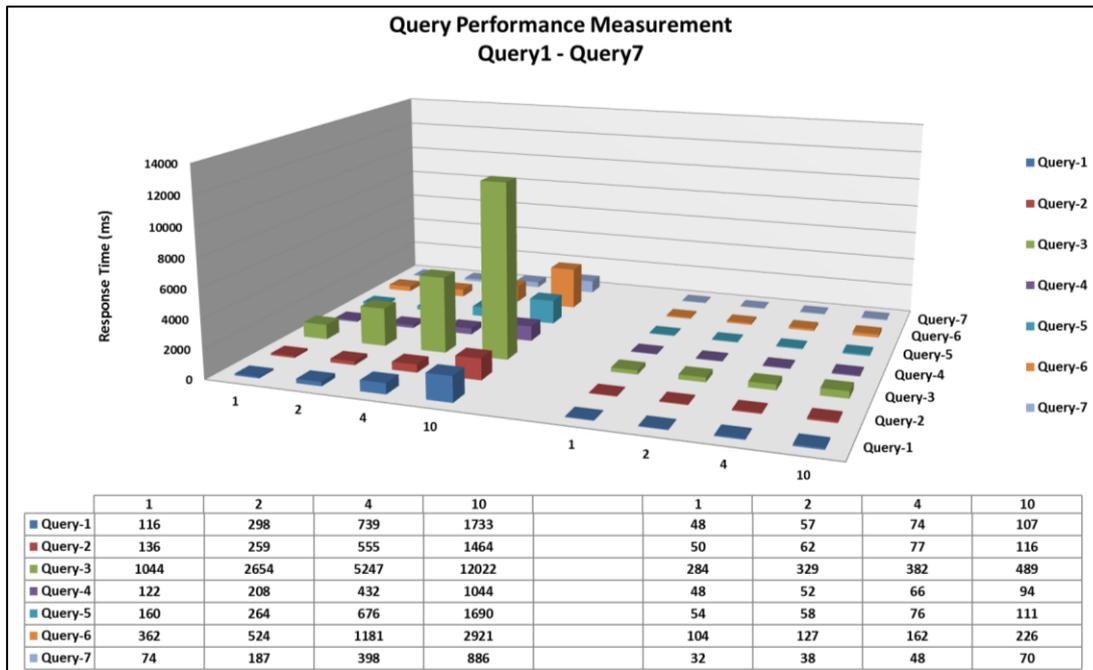


Figure 3.9: Performance measurement results.

Even though how much the size of the designed database is increased, response times of the designed database (performance measurement) is always better/faster than the original database.

CHAPTER 4

A WEB-BASED URBAN CONSERVATION TOOL

4.1 Data and Data Types taken from Institutions

Different kinds of data were obtained from various institutions (Table 4.1). The spatially referred data and attribute data was mostly collected as a result of site studies done in 2010-2011 by Odunpazarı CDP (Conservation Development Plan) team. Odunpazarı CDP team consists of various disciplines including architects, conservation architects, city planners, art historians, landscape architects and civil engineers. Data about historic buildings and inhabitants were obtained from the literature, archival and site surveys, which was then followed by the analysis done by CDP team [25].

Table 4.1: Data and data types taken from Institutions.

INSTITUTIONS	DATA	DATA TYPE
<i>Odunpazarı Municipality</i>	Structures Information	MS Access (accdb) file
	Urban Site Area Map	CAD (Digital Map) Data
	Structure Information Sheets	PDF file documents
	Aerial and Satellite Photos	Raster Image Data
	Analysis Maps	Raster Data
	Conservation Aimed Development Plan	Raster Data
	Structures Current Status Layouts	PDF file documents
	Structures Decision Layouts	PDF file documents
	Archieve Documents	PDF/JPEG files
<i>Eskişehir Conservation Board of Cultural and Natural Values</i>	Registration Sheets	PDF file documents
<i>Eskişehir Provincial Directorate of Land Registry and Cadastre</i>	Land Registry Records	MS Excel (xls) file

The spatially referred vector data (Figure 4.1) and attribute data (structure information database) that obtained from Odunpazarı CDP were taken from Odunpazarı Municipality. Odunpazarı original database table contains information about structures in the urban site area (Figure 4.2).

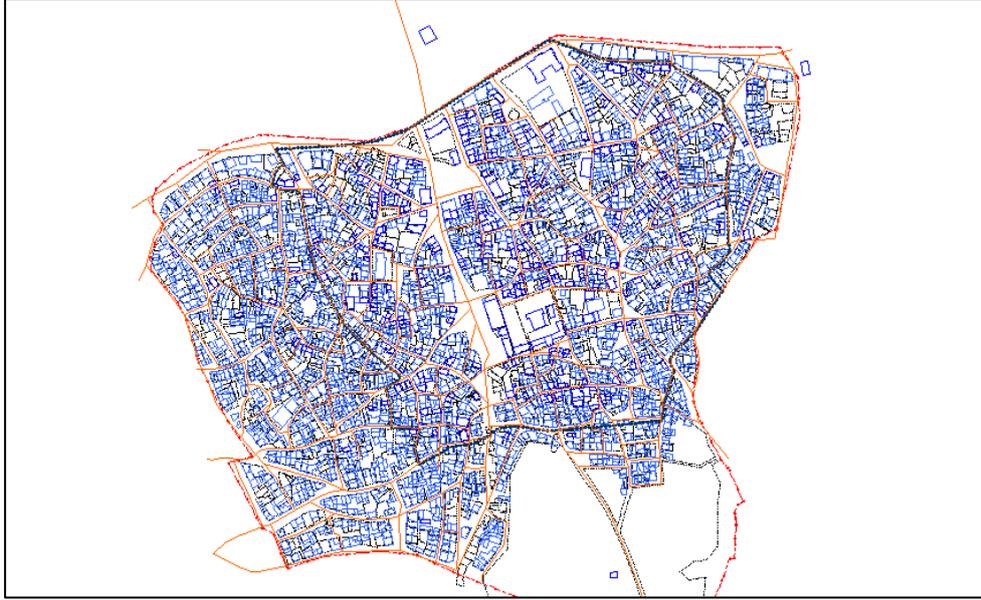


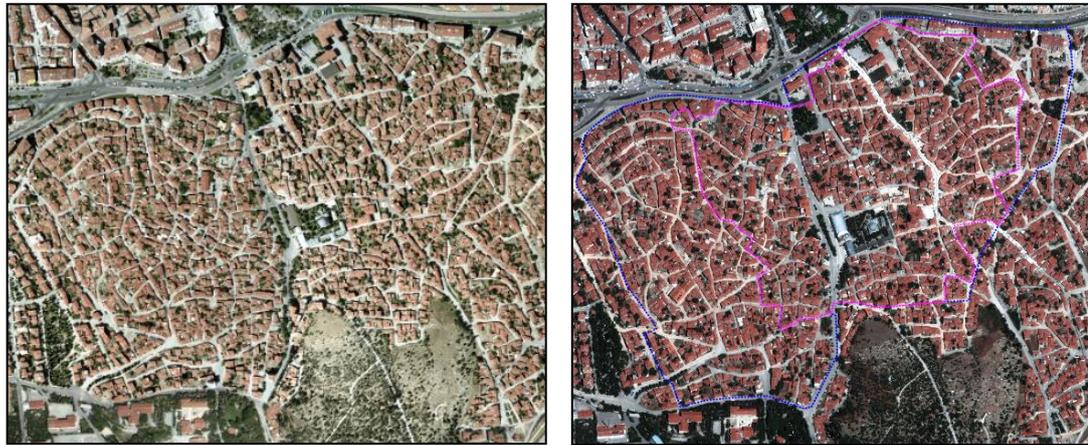
Figure 4.1: CAD (Vector) data taken from Odunpazarı Municipality.

ID	Adres	MahalleAdi	GOYapi	KatYuksekligi	Tarih	YapimYili	Pafta	Ada	Parsel	OnarimGormus
B3-56-4	BEYLER SOKAK NO:34	PAŞA	<input type="checkbox"/>	1	17.6.2010		B3	56	4	<input type="checkbox"/>
B3-56-5	BEYLER SOKAK NO:36	PAŞA	<input checked="" type="checkbox"/>	1	17.6.2010		B3	56	5	<input type="checkbox"/>
B3-56-7A	KEMAL ZEYTİNOĞLU CADDESİ NO:39	PAŞA	<input checked="" type="checkbox"/>	2	17.6.2010		B3	56	7A	<input type="checkbox"/>
B3-56-7B	KEMAL ZEYTİNOĞLU CADDESİ NO:41	PAŞA	<input type="checkbox"/>	1	17.6.2010		B3	56	7B	<input type="checkbox"/>
B4-58-1	ÇÜRÜK HOCA SOKAK NO:7	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	1	<input type="checkbox"/>
B4-58-10A	TİRYAKİ HASAN PAŞA SOKAK NO:6	PAŞA	<input checked="" type="checkbox"/>	1	18.6.2010		B4	58	10A	<input type="checkbox"/>
B4-58-10B	TİRYAKİ HASAN PAŞA SOKAK NO:8	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	10B	<input type="checkbox"/>
B4-58-12	KURŞUNLU CAMİİ SOKAK NO:18	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	12	<input type="checkbox"/>
B4-58-13	KURŞUNLU CAMİİ SOKAK NO:20	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	13	<input type="checkbox"/>
B4-58-14	KURŞUNLU CAMİİ SOKAK NO:	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	14	<input type="checkbox"/>
B4-58-16	ÇÜRÜK HOCA SOKAK NO:11	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	16	<input type="checkbox"/>
B4-58-17	ÇÜRÜK HOCA SOKAK NO:9	PAŞA	<input checked="" type="checkbox"/>	2	18.6.2010		B4	58	17	<input type="checkbox"/>
B4-58-18	KURŞUNLU CAMİİ SOKAK NO:10	PAŞA	<input checked="" type="checkbox"/>	3	18.6.2010		B4	58	18	<input type="checkbox"/>
B4-58-20	BEYLER SOKAK NO:21	PAŞA	<input type="checkbox"/>	2	18.6.2010		B4	58	20	<input type="checkbox"/>
B4-58-2A	BEYLER SOKAK NO:23	PAŞA	<input checked="" type="checkbox"/>	1	18.6.2010		B4	58	2A	<input type="checkbox"/>
B4-58-2B	ÇÜRÜK HOCA SOKAK NO:5	PAŞA	<input checked="" type="checkbox"/>	3	18.6.2010		B4	58	2B	<input type="checkbox"/>
B4-58-6	BEYLER SOKAK NO:17	PAŞA	<input type="checkbox"/>	1	18.6.2010		B4	58	6	<input type="checkbox"/>
B4-58-7A	BEYLER SOKAK NO:13	PAŞA	<input checked="" type="checkbox"/>	1	18.6.2010		B4	58	7A	<input type="checkbox"/>

Figure 4.2: MS Access Original database table taken from Odunpazarı Municipality.

Aerial photo (Figure 4.3a) and satellite image (Figure 4.3b) were taken from Odunpazarı Municipality. Thematic analysis maps such as Land Use Analysis,

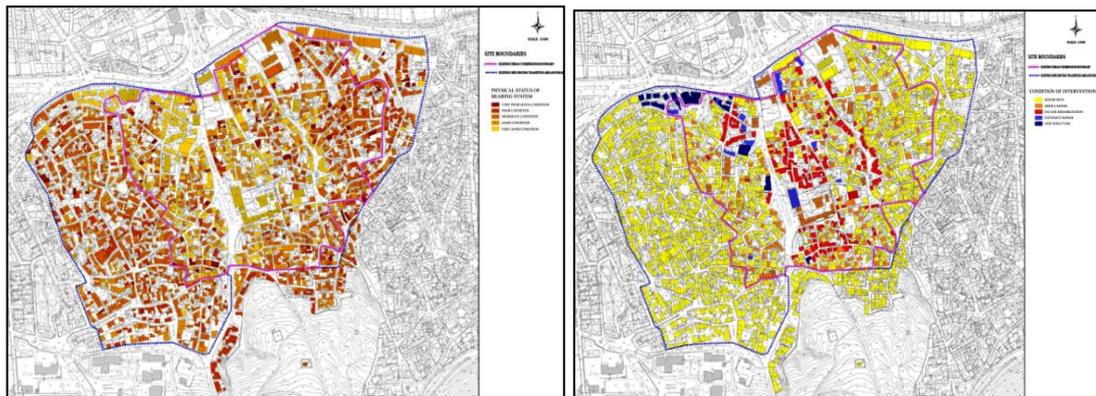
Structural Condition Analysis (Figure 4.4a), Interventions to Buildings (Figure 4.4b), etc. which were created by Odunpazarı CDP members, were taken and saved as geo-tiff files after geo-referencing process. Coordinate equivalence was done between analysis maps and vector data.



(a) Aerial Photo

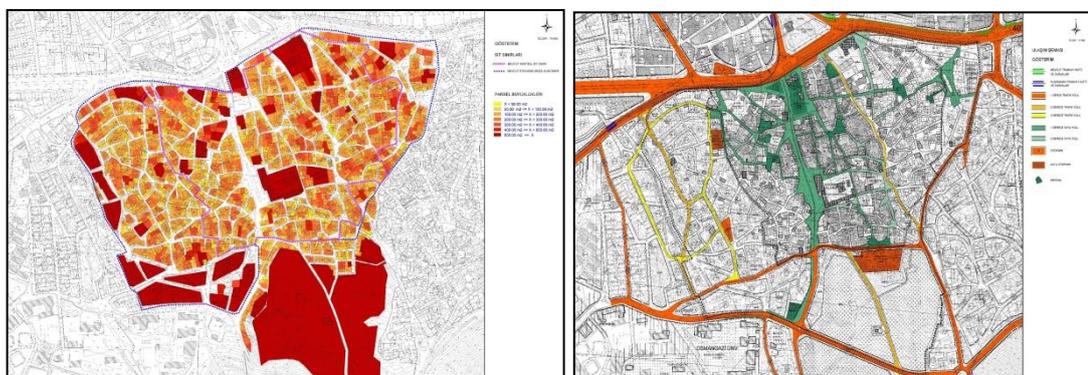
(b) Satellite Image

Figure 4.3: Raster data taken from Odunpazarı Municipality.



(a) Structural Condition

(b) Interventions to Buildings



(c) Lot Dimensions

(d) Transportation Scheme

Figure 4.4: Thematic analysis map samples (Özkut and Yılmaz, 2011).

Land registry records were taken from Provincial Directorate of Land Registry and Cadastre and Odunpazarı Municipality as MS Excel file (Figure 4.5). Land registry records include information about address, land registry information (volume number, page number), property information (type, area), owner's personal information (TC identification number, name, surname, etc.), the reason and the date. MS Excel data file has been changed to MS Access database file.

	C	D	E	F	G	H	I	J	K	L	M	N
	MahalleAdi	KurumAdi	Ada	Parsel	AnaTasınmazCinsAdi	YuzOlcumu	TCKimlikNo	Adi	Soyadi	HisseOrani	EdinmeSebebi	EdinmeTarih
2	ALANÖNÜ MAHALLESİ	Odunpazarı	951	23	Mesken - Kerpiç	126	#####	ZEYNEP AHSEN	#####	0/1	İntikal	14.09.1992
3	AKÇAĞLAN MAHALLESİ	Odunpazarı	855	17	Mesken - Bahçeli - Kargir	621	#####	İBRAHİM	#####	0/1	Tesis Kadastro	18.05.1949
4	KARACAŞEHİR MAHALLESİ	Odunpazarı	82	1	Tanım Arazisi	2670	#####	AYGUT	#####	0/1	Satış Suretiyle Pay Temliki	08.09.2000
5	KARACAŞEHİR MAHALLESİ	Odunpazarı	82	1	Tanım Arazisi	2670	#####	RAHİME	#####	0/1	İntikal	08.09.2000
6	KARACAŞEHİR MAHALLESİ	Odunpazarı	82	1	Tanım Arazisi	2670	#####	ÖMER	#####	0/1	İntikal	08.09.2000
7	AKÇAĞLAN MAHALLESİ	Odunpazarı	863	4	Mesken - Ahşap	83	#####	LÜTFİYE	#####	0/1	İntikal	09.06.1955
8	KARACAŞEHİR MAHALLESİ	Odunpazarı	82	1	Tanım Arazisi	2670	#####	ASLIHAN	#####	0/1	İntikal	08.09.2000
9	KARACAŞEHİR MAHALLESİ	Odunpazarı	82	1	Tanım Arazisi	2670	#####	FİTNAT	#####	0/1	İntikal	08.09.2000
10	AKÇAĞLAN MAHALLESİ	Odunpazarı	860	9	Mesken - Bahçeli - Ahşap	330	#####	AHMET	#####	0/1	Satış Suretiyle Pay Temliki	24.04.1997
11	CUNUDİYE MAHALLESİ	Odunpazarı	138	37	Arsa	200	#####	YALÇIN	#####	0/1	İntikal	12.09.1990
12	ALANÖNÜ MAHALLESİ	Odunpazarı	951	23	Mesken - Kerpiç	126	#####	CELAL	#####	0/1	İntikal	14.09.1992
13	KARACAŞEHİR MAHALLESİ	Odunpazarı	82	1	Tanım Arazisi	2670	#####	BARBAROS	#####	0/1	İntikal	08.09.2000
14	ALANÖNÜ MAHALLESİ	Odunpazarı	951	23	Mesken - Kerpiç	126	#####	ALİ NAZİM	#####	0/1	İntikal	14.09.1992
15	ORTA MAHALLESİ	Odunpazarı	917	6	Mesken - Bahçeli - Ahşap	232.5	#####	BEHİYE	#####	0/1	Tesis Kadastro	27.02.1942
16	ORTA MAHALLESİ	Odunpazarı	917	6	Mesken - Bahçeli - Ahşap	232.5	#####	FAİK	#####	0/1	Tesis Kadastro	27.02.1942
17	ORTA MAHALLESİ	Odunpazarı	917	6	Mesken - Bahçeli - Ahşap	232.5	#####	HASAN	#####	0/1	Tesis Kadastro	27.02.1942
18	CUNUDİYE MAHALLESİ	Odunpazarı	1751	7	Mesken - Bahçeli - Kargir	274	#####	TAYFUN	#####	0/1	Satış	20.10.2003

Figure 4.5: Land registry records taken from Eskişehir Provincial Directorate of Land Registry and Cadastre.

Conservation Development Plan (Figure 4.6), which includes boundaries of protected area and plan boundary, construction decisions, conservation decisions, land-use decisions and transportation decisions about study area, was taken from Odunpazarı Municipality and saved as geo-tiff file after geo-referencing process.

that include drawings of the buildings with decided new building heights were taken from Odunpazarı Municipality. Registration Sheet (Figure 4.10) that include information about conservation status, location, specifications, technical information, image and promotion of the cultural property were taken from Eskişehir Regional Conservation Council of Cultural Properties.

Hazırlayan AYSEL DENİZ Tarih 12.6.2010	MEVCUT İŞLEV	Yapım Yılı	KADASTRAL BİLGİLE
ID A4-52-13 Kat Yüksekliği 3	Zemin Kat TİCARET <input type="checkbox"/> Özgün <input checked="" type="checkbox"/> Değişmiş	YAPININ GENEL FİZİKSEL DURUMU Pafta Ada Parsel 1 2 3 4 5 A4 52 13	MÜLKİYET
Mahalle Adı PAŞA Geleneksel Özellikte Yapı <input checked="" type="checkbox"/>	Diğer Katlar TİCARET <input type="checkbox"/> Özgün <input checked="" type="checkbox"/> Değişmiş	Onarım Görmüş <input checked="" type="checkbox"/> Vakıf Kamu Özel	Onarım Görmemiş <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>
Adres		Cephe Sağıklaştırılması <input type="checkbox"/>	Cephe Tipolojisi 3 Katlı Sokaktan Giriş Geniş Cepheli Tek Çıkım
YAPININ DÖNEMLERİ			Cephe Tipolojisi 3 Katlı Sokaktan Giriş Dar Çephe Çıkmalı
1 2 3 4	Foto 	PI ANI TİPİ	Cephe Tipolojisi
A <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	YAPININ TESCİL DURUMU	SOFA BİR YANINDA ODA	DIŞ SOFALI PLAN TİPİ
B <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> Korunması Gerekli Nitelikli Yapı	<input type="checkbox"/> Merdiven Sofa Kenarında	SOFA İKİ YANINDA ODA
C <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> Tescilli Yapı	<input type="checkbox"/> Merdiven Sofa Köşesinde	SOFA ARADA
TAŞIYICI SİSTEM	<input type="checkbox"/> Plan Kararlarına Göre Korunacak Yapı	<input type="checkbox"/> M. Sofa Kenarında	<input type="checkbox"/> Merdiven Sofa Kenarında
<input type="checkbox"/> Aşya Karkas	<input type="checkbox"/> Diğer Yapılar	<input type="checkbox"/> M. Sofa Köşesinde	<input type="checkbox"/> M. Sofa Köşesinde
<input type="checkbox"/> Yiğma	TAŞIYICI SİSTEM	İÇ SOFALI PLAN TİPİ	<input type="checkbox"/> Merdiven Sofa Kenarında
<input checked="" type="checkbox"/> Betonarme Karkas	<input type="checkbox"/> Aşya Karkas	<input type="checkbox"/> Merdiven Sofa Köşesinde	<input type="checkbox"/> Merdiven Sofa Sonunda
Notlar	<input type="checkbox"/> Yiğma	<input type="checkbox"/> Merdiven Sofa Sonunda	<input type="checkbox"/> Merdiven Sofa Arasında
Yapının Konumu	<input checked="" type="checkbox"/> Betonarme Karkas	ORTA SOFALI PLAN TİPİ	<input type="checkbox"/> Merdiven Sofa Arasında
<input type="checkbox"/> Ayrık Nizam	<input checked="" type="checkbox"/> İki Taraftan Bitişik	CEPHE	
<input type="checkbox"/> Tek Taraftan Bitişik	<input checked="" type="checkbox"/> İki Taraftan Bitişik	FİZİKSEL DURUM	KAPLAMA MALZEMESİ
		1 2 3 4 5 <input type="checkbox"/> Ahşap <input type="checkbox"/> Taş <input type="checkbox"/> Sıva <input checked="" type="checkbox"/> Boya <input checked="" type="checkbox"/> Diğer <input type="checkbox"/> Deformasyon / Sehim <input type="checkbox"/> Çatlak	<input type="checkbox"/> Ahşap <input type="checkbox"/> Taş <input type="checkbox"/> Sıva <input checked="" type="checkbox"/> Boya <input checked="" type="checkbox"/> Diğer <input type="checkbox"/> Deformasyon / Sehim <input type="checkbox"/> Çatlak
		Notlar	<input type="checkbox"/> Eskime <input type="checkbox"/> Notlar <input type="checkbox"/> Kırık
			<input type="checkbox"/> Çürüme <input type="checkbox"/> Diğer
	Plan 		

Figure 4.7: Building Information Form / *Yapı Bilgi Föyü* (Özkut and Yılmaz, 2011).

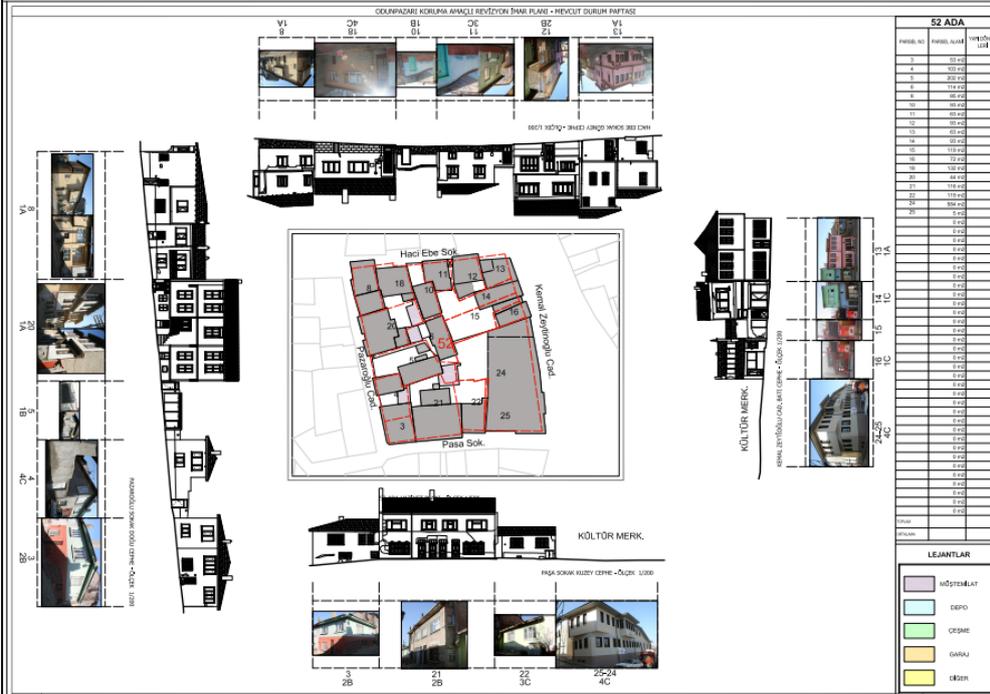
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Figure 4.8: Current Status Sheet / *Mevcut Durum Paftası* (Özkut and Yılmaz, 2011).



Figure 4.9: Building Decisions Sheet / *Yapı Kararları Paftası* (Özkut and Yılmaz, 2011).

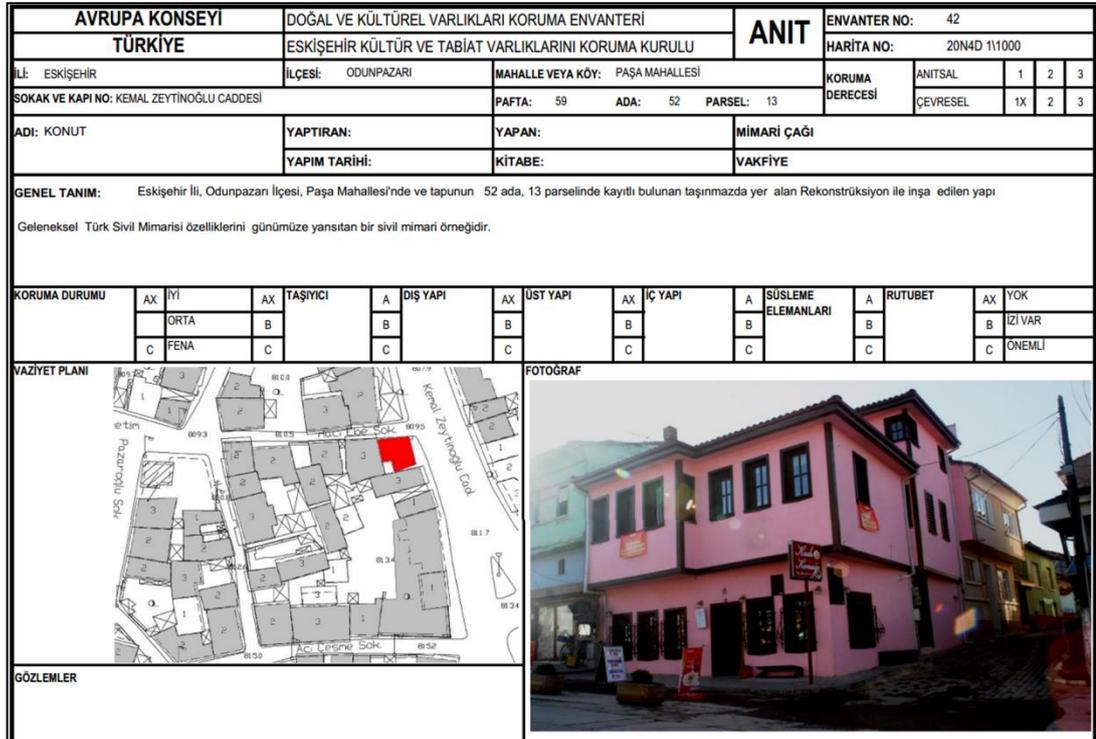


Figure 4.10: Registration Sheet taken from Eskişehir Regional Conservation Council of Cultural Properties.

Archive documents like petitions, land registry documents, zoning status documents, architecture projects, building licence, settlement status document, Conservation Council correspondences, etc. were taken from Odunpazarı Municipality (Figure 4.11).

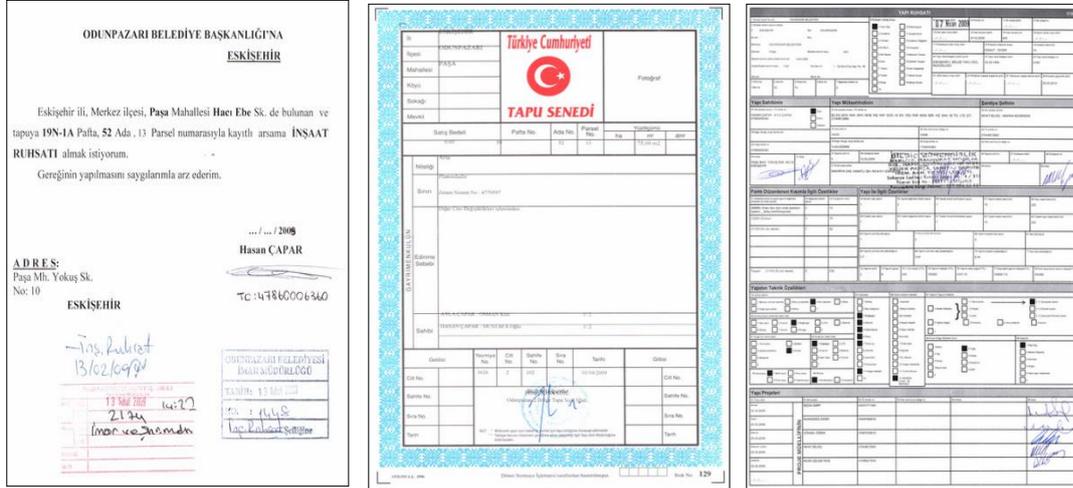


Figure 4.11: Archive Documents taken from Odunpazarı Municipality (Petition, Land Registry Record and Building Licence).

Historical and contemporary visual and written documents like photos and videos of the buildings were taken from institutions and inhabitants or obtained from field.

4.2 Designing System Architecture

Server side architecture was chosen as the Web-based GIS system architecture type and the system is designed through server side architecture. Choosing the most proper programming language is an important issue before constructing a web-based GIS system. An open-source server-side scripting language which is relatively easy to be developed and has a fast access to various database systems was chosen.

Different kinds of programs and technologies, mostly open source, were used for the study;

- PostgreSQL is used for databases which include vector data, attribute data and properties of building.
- BelsisCAD and ArcGIS were used for geo-referencing raster data and saving vector data as shp files.
- Geoserver used as a map server, both the raster and vector data published in Geoserver. (Geoserver uses shp files as vector data)

- OpenLayers and JQuery used as a JavaScript library for displaying map data in web browsers,
- HTML5 and CSS3 used for web interface design,
- Google Maps API used to integrate Google Maps with web-based application
- Visual Studio used as code editor and debugger. HTML codes, CSS codes, ASP codes and JavaScript codes were written with Visual Studio.

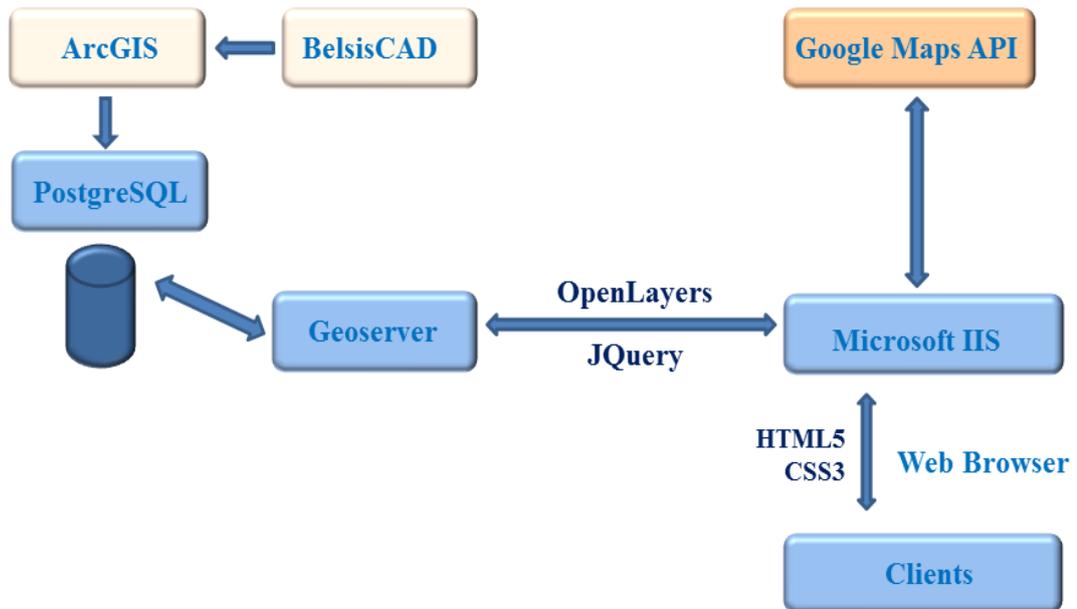


Figure 4.12: Software and Technologies used for Web-Based GIS.

The client has a personal computer running a Web browser. With user interface, client generates requests to the application server via HTTP and displays resulting HTML file in a Web browser. The Web server receives requests from the client, and then passes to the application server. The application server processes requests. The application server makes requests to the data repository that includes relational database and spatial database.

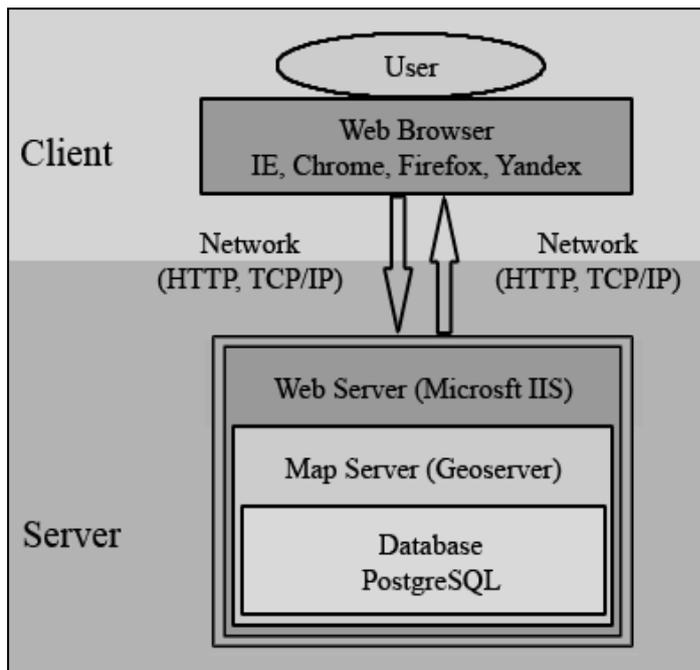


Figure 4.13: Components of the Web-Based GIS Application.

The integration process of different data types and programs used as components of web-based GIS were done with MS Visual Studio using C# and JavaScript programming languages. The data from PostgreSQL are pulled by using C# and the structure of ado.net inside C#. JavaScript and other languages are allowed to access data obtained via web services in asp.net. JavaScript enables to convert the data to HTML and to display in the browser by pulling the data from the web service. C#, asp.net and JavaScript connections are provided by web services.

MS Access database (land registry data), PostgreSQL and PostGIS integration to web application, html content definition, etc. were coded with C# (cs) language in Visual Studio. Scripts are crucial for web based applications. Java Scripts were used for integration of jQuery, jSon and OpenLayers, identification of projection (EPSG) and mainly used for defining application's functions and the way of working.

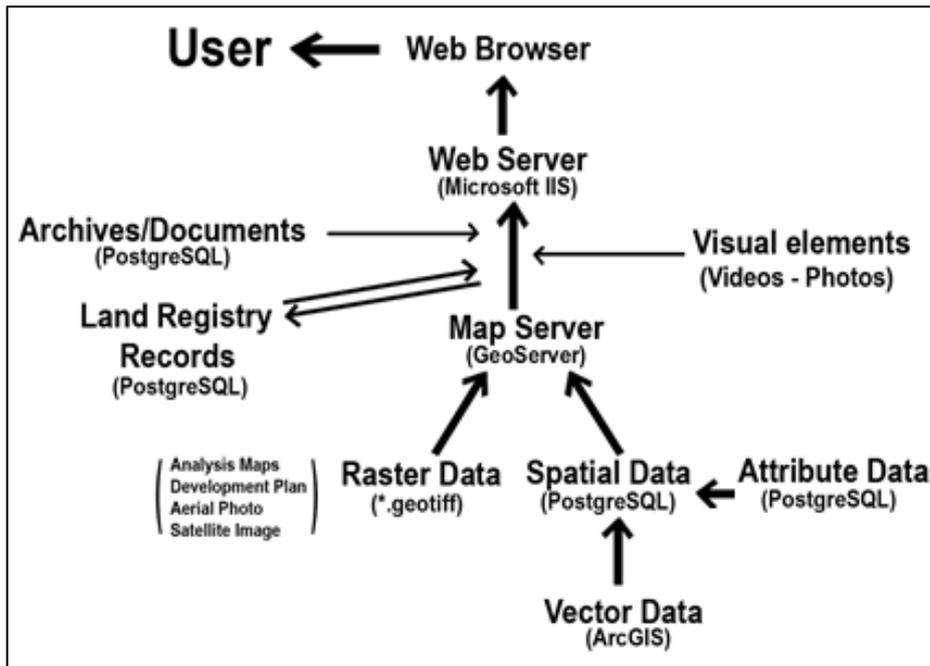


Figure 4.14: Web-Based GIS system components and their relation.

GIS vector data was saved as shapefile (shp) file format and transferred to PostgreSQL as a spatial data with the help of PostGIS (Figure 4.15). Raster data (Aerial photo, satellite image, conservation development plan, base map and thematic analysis maps) were geo-referenced in GIS technology and saved as geo-tiff data format. After doing this process, raster data can be used as an underlay to vector data. PostGIS/PostgreSQL vector data and raster data were transferred to GeoServer as layers and published (Figure 4.16). EPSG codes and styles of vector data layers were given in GeoServer.

gid	serial	kapi_no	sokak_adi	ada_parsel	mahalle	ada	parsel	donemler	adi	tall_k_no	tescil_chara
1	1	5	HACI HAFIZ	130/28	SARKIYE MAH 130	28	4B	-	-	-	-
2	2	6/A	ARMETLER	SK 136/18	CUNUDIYE MAH 136	18	4C	-	-	-	-
3	3	2	YEŞİL EFENDİ	69/7	DEDE MAHALLE 69	7	4B	-	-	-	Korun
4	4	56	KENAL ZEYİNİ	52/24	PAŞA MAHALLE 52	24	4C	BIRLIK VAKFI	-	-	-
5	5	10	MESCI SK.	128/2	CUNUDIYE MAH 128	2	4B	-	-	-	-
6	6	15	PAŞALAR SK.	105/16	DEDE MAHALLE 105	16	1C	-	-	-	-
7	7	19	KOLBAŞI SK.	932/3-4	ALANÖNÜ MAH 932	3-4	3C	-	-	-	-
8	8	9	ALAEDDİN CA	165/2	DELİKLİTAŞ 165	2	-	SULTAN ALLA	-	-	Tescil
9	9	48/2	CİMHURİYET	953/12	ALANÖNÜ MAH 953	12	4C	-	-	-	-
10	10	26	BEKİR ÇAVUŞ	930/18	ALANÖNÜ MAH 930	18	2C	-	-	-	-
11	11	-	AKOĞLAN SK.	930/14	ALANÖNÜ MAH 930	14	1B	-	-	-	-
12	12	18	AKOĞLAN SK.	930/13	ALANÖNÜ MAH 930	13	1B	-	-	-	-
13	13	25	BEKİR ÇAVUŞ	951/3	ALANÖNÜ MAH 951	3	1B	-	-	-	-
14	14	26	AKOĞLAN SK.	930/16	ALANÖNÜ MAH 930	16	1B	-	-	-	Korun
15	15	24	BEKİR ÇAVUŞ	930/10	ALANÖNÜ MAH 930	10	1A	-	-	-	Tescil

Figure 4.15: Spatial data layers in PostgreSQL.

Layers

Manage the layers being published by GeoServer

Results 26 to 50 (out of 68 items)

<input type="checkbox"/>	Type	Workspace	Store	Layer Name	Enabled?	Native SRS
<input type="checkbox"/>		op	op_vector	op_sit_kamu_kurulusu_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_kulluye_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_mahalle_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_muzeler_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_okullar_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_onama_sinir_lines	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_parseller_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_sagliklastirma_lines	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_sit_siniri_lines	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_sokak_lines	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_tescilli_yapilar_polygons	✓	EPSG:2320
<input type="checkbox"/>		op	op_vector	op_sit_turbe_polygons	✓	EPSG:2320

Figure 4.16: Vector (shp) & raster (geo-tiff) layers in GeoServer.

Visual Studio was used in many parts of the web-based GIS programming process. C# codes, Java scripts, ASPX, HTML and CSS codes were written with Visual Studio.

4.3 Designing Web Application Interface

Web-based GIS application interface was developed with MS Visual Studio using CSS3 and HTML5 technologies. HTML and CSS are two of the core technologies for building Web pages. While HTML provides the structure of the page, CSS provides the (visual and aural) layout, for a variety of devices. Styles of the web pages are described in CSS (.css) files. Data services and web services are defined with ASP.NET (aspx, asmx, asax etc.) web application development technology.

After all configurations had been done in Visual Studio project/solution, project was published. After project is published, websites were added in Microsoft IIS (Web Server) technology (Figure 4.17). Then, website names, physical paths of the files and port information were given. Advanced settings were made for web site, for example, user permissions were assigned. And then Application Pools advanced settings were made. Different user groups exist, so three websites were defined for each user group. Websites are serving web-based application in different ports or web addresses. Web-based GIS applications interface and user capabilities are described differently from each other according to needs of users.

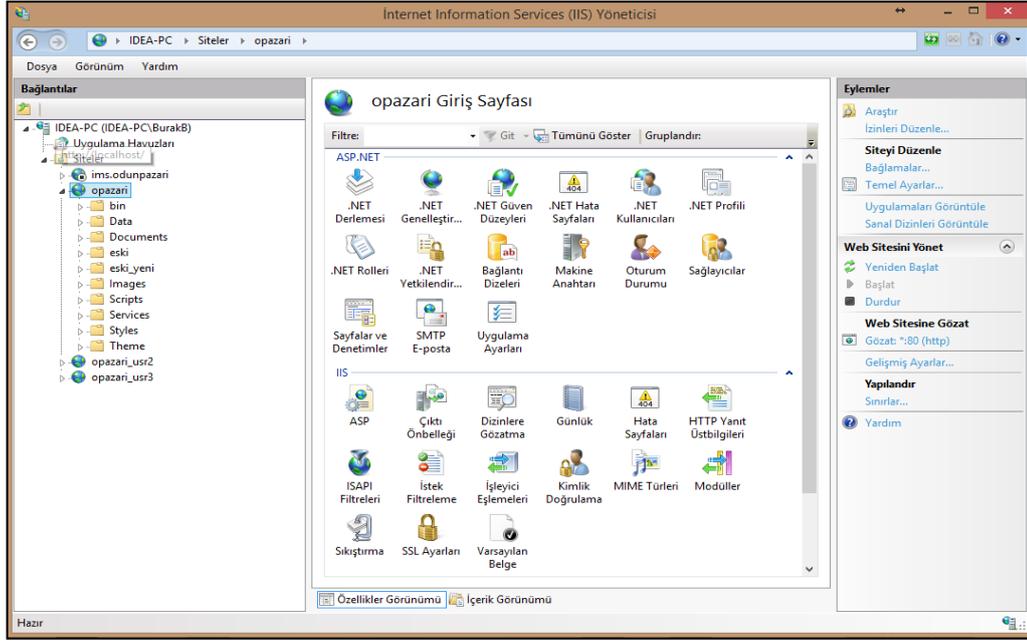


Figure 4.17: Prepared websites for user groups in IIS.

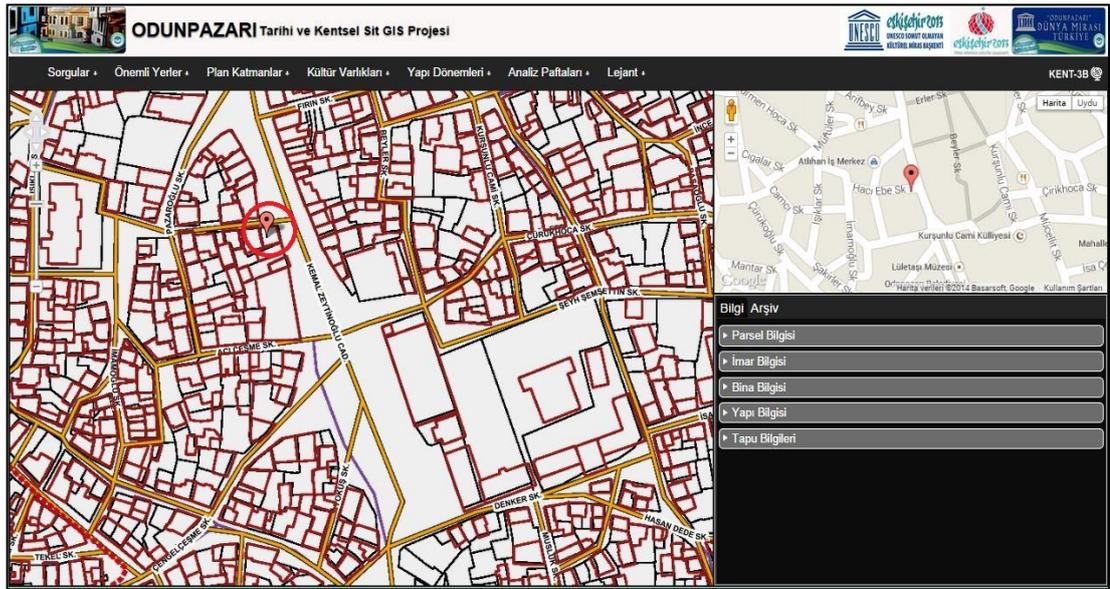


Figure 4.18: Web-based GIS application main page

Project interface consists of five main sections (Figure 4.18). In the first section, main title (name) of the application and related logos about study area are located. In the second section, there is a menu bar which contains queries, layers, analysis maps and legend. In the third section, there is a map panel which contains the vector data of the study. In the fourth section of the web page in upper middle panel, Google map is located which works relatively with the base map. In the last part of the web page in lower middle panel, information about objects contained in the digital data and archive documents about structures are situated.

On the menu bar, the first title is the queries menu (Figure 4.19). Queries menu contains five frequently used query methods. These queries are; query with parcel number, query with address, query with landmark type, query with registration number and query with structure features (carrier system, repair status, ownership, etc.).



Figure 4.19: Queries menu with frequently used queries.

Structures can be queried by selecting lot number and parcel number (Figure 4.20). If only the lot number is selected in the query, user can see the list of the parcels which are located in the selected lot. After selecting lot number, parcel combo-box is filled with related parcel numbers for easy selection.

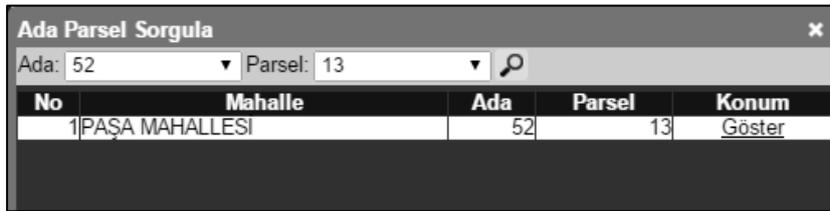


Figure 4.20: Query with lot number (Ada= 52 and Parsel= 13).

Structures can be queried with address information (Figure 4.21). Query with address can be done by selecting neighbourhood, street and building number. After selecting neighbourhood, street combo-box is filled with related streets of selected neighbourhood. By selecting both neighbourhood and street, building number combo-box is filled with related building numbers.

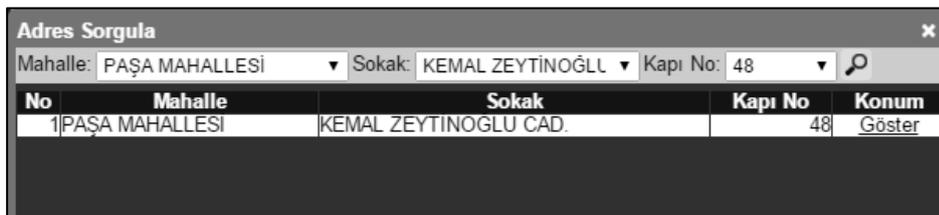


Figure 4.21: Query with address information

(Mahalle= 'PAŞA MAHALLESİ' and Sokak= 'KEMAL ZEYTİNOĞLU CAD.' and Kapı_no= '48')

Landmarks can be queried by selecting landmark types (Figure 4.22). By querying with landmark type, user can see the list of related landmarks and their addresses. In this query, neighbourhood and street can also be selected to do more specific queries. Registered structures can also be specifically queried with registration numbers (Figure 4.23).

No	Tür	Adı	Mahalle	Sokak	Kapı No	Konum
1	TURBE	YEŞİL EFENDİ (AHU MAHMUT) TURBESİ	DEDE MAHALLESİ	SEMERCI SK.	2	Göster
2	TURBE	MEVLEVI KABIRLARI	DEDE MAHALLESİ	DENKER SK.	-	Göster
3	TURBE	ŞEYH NUSREDDİN TURBESİ	DEDE MAHALLESİ	ŞEYH NUSRETTİN SK.	6	Göster
4	TURBE	ŞEYH EDEBALI TURBESİ	DEDE MAHALLESİ	HACI EYUP SK.	-	Göster
5	TURBE	ŞEYH ŞAHABBETİN TURBESİ	PAŞA MAHALLESİ	KEMAL ZEYTİNOĞLU CAD.	64	Göster

Figure 4.22: Query with landmark type (Tür= ‘Türbe’)

No	Mahalle	Sokak	Ada	Parsel	Konum
1	PAŞA MAHALLESİ	KEMAL ZEYTİNOĞLU CAD.	52	13	Göster

Figure 4.23: Query with registration number (Tescil_no= 42)

The last query method is the query with structure features. Query with structure features is slightly different than other queries. They are customized queries defined for urban conservation. Queries can be done with several different feature types (Figure 4.24). By using these building feature queries, users can see the list of the buildings according to the structure features (carrier system, repair status, ownership, etc.).

Tür	Değer
Mülkiyet	Seçiniz.
Seçiniz.	Seçiniz.
Yapı Dönemi	Kamu Mülkiyeti
Tescil Durumu	Özel Mülkiyet
Taşıyıcı Sistem	Vakıf Mülkiyeti
Mülkiyet	
Kat Yüksekliği	
Onarım Durumu	
Yapı Nizamı	

Figure 4.24: Customized building features queries.

At first, user selects the structure feature type. Then, user selects the related value from the value combo-box to make query. By querying with ownership, user can see the list of related ownerships and their addresses (Figure 4.25).

No	Mahalle	Sokak	Kapı No	Konum
1	AKARBAŞI MAHALLESİ	ATATURK BUL.	55	Göster
2	AKARBAŞI MAHALLESİ	DEPBOY SK.	11	Göster
3	AKARBAŞI MAHALLESİ	DEPBOY SK.	13	Göster
4	AKARBAŞI MAHALLESİ	DEPBOY SK.	15	Göster
5	AKARBAŞI MAHALLESİ	DEPBOY SK.	17	Göster
6	AKARBAŞI MAHALLESİ	DEPBOY SK.	19	Göster
7	AKARBAŞI MAHALLESİ	DEPBOY SK.	21	Göster
8	AKARBAŞI MAHALLESİ	DEPBOY SK.	21/A	Göster
9	AKARBAŞI MAHALLESİ	DEPBOY SK.	23	Göster
10	AKARBAŞI MAHALLESİ	DEPBOY SK.	27	Göster

Figure 4.25: Query with ownership.

Second title on the menu bar is the landmarks layers menu (Figure 4.26). There are four categories in landmark layers menu; pharmacies, schools, public institutions and associations. Landmark layers optionally can be opened or closed. All layers have different fill colours. Landmark layers can be seen thematically on the base map.

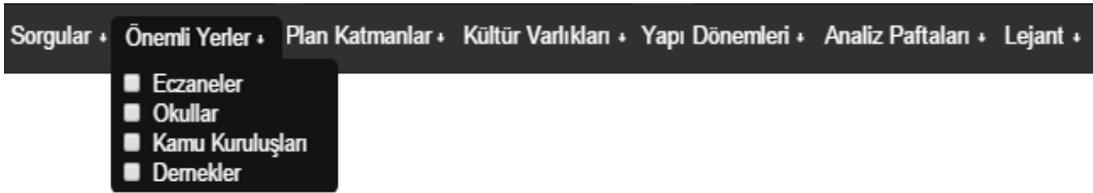


Figure 4.26: Landmark layers menu.

Third title on the menu bar is the plan layers menu (Figure 4.27). There are eight sub-titles in plan layers menu; buildings, parcels, streets, neighbourhoods, development plan, satellite image, aerial photograph. Plan layers optionally can be opened or closed. Conservation development plan, satellite photograph, aerial photograph and base map are raster (geo-tiff) data. Layers visual styles such as colour, feature type and etc. were described in Geoserver.

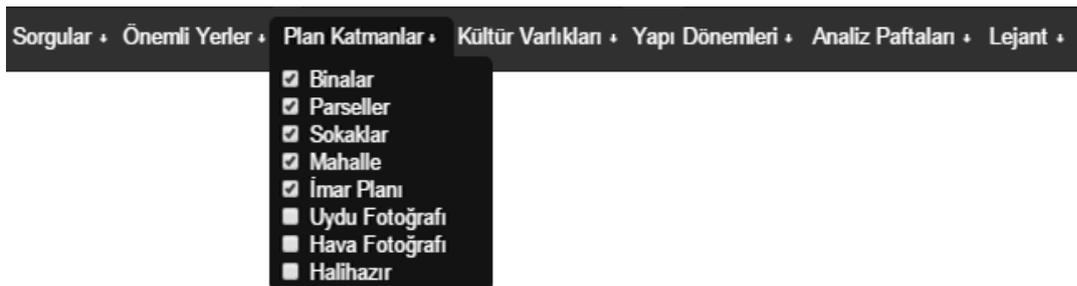


Figure 4.27: Plan layers menu.

Fourth title on the menu bar is the cultural properties layers menu (Figure 4.28). There are eleven sub-titles in the cultural properties layers menu. These are; site boundary, acceptance boundary, registered structures, structure decisions layout, street rehabilitation, mosque, “külliye” (complex of buildings adjacent to a mosque), museum, “türbe” (a mausoleum building which contains the grave of a famous person or a wealthy family), fountain, registered trees. Cultural properties layers optionally can be opened or closed. Structure decisions layout is raster map data which were previously passed geo-referencing process. Layers have their styles.

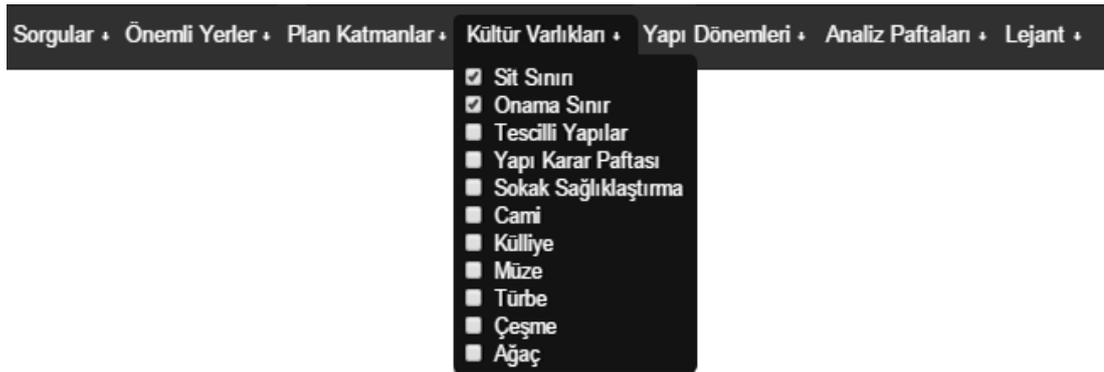


Figure 4.28: Cultural properties layers menu.

Fifth title on the menu bar is the construction periods of structures' menu (Figure 4.29). There are thirteen sub-titles in construction periods menu; all periods, period 1A, 1B, 1C, period 2A, 2B, 2C, period 3A, 3B, 3C, period 4A, 4B, 4C.



Figure 4.29: Construction periods menu.

Periods were determined by Odunpazarı KAİP project members (Table 4.2). Period numbers (1,2,3,4) are providing information about the build period. And the characters (A, B, C) are providing information about buildings' historical

importance. Construction periods optionally can be opened or closed. At the first sub-title of the menu, there is a checkbox that opens and closes all the construction periods. Each period has different fill colour. Construction periods can be seen thematically on the base map.

Table 4.2: Construction periods and characteristics (Özkut and Yılmaz, 2011).

1A	Traditional Period	19 th Century and Before/Rich
1B	Traditional Period	19 th Century and Before/Qualified
1C	Traditional Period	19 th Century and Before/Modest
2A	Transition Period	1900-40, Rich
2B	Transition Period	1900-40, Qualified
2C	Transition Period	1900-40, Modest
3A	Modern Period	1940-60, Rich
3B	Modern Period	1940-60, Qualified
3C	Modern Period	1940-60, Modest
4A	Late Period	1960-..., Rich
4B	Late Period	1960-..., Qualified
4C	Late Period	1960-..., Modest

Sixth title on the menu bar is the analysis maps menu (Figure 4.30). There are fourteen maps (geo-tiff & jpeg) in the analysis maps menu. First one is first development plan of Eskişehir, which was prepared in 1896. And the others are these; the current development plan, development plan revision map, neighbourhood boundaries map, transportation schema map, road pavement condition map, site boundary map, condition of intervention map, land use map, number of storey map, carrier system of structures map, ownership status map, size of the lot map and physical condition of buildings map.

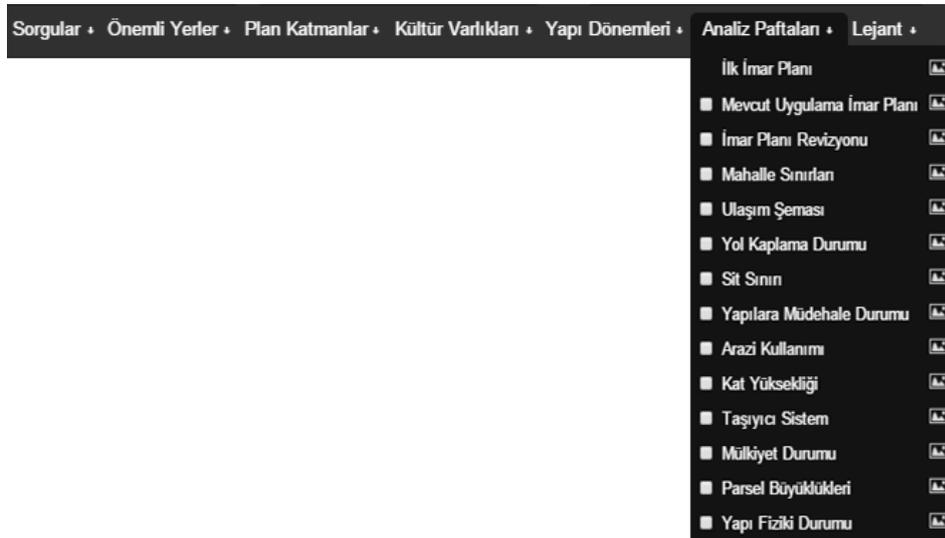


Figure 4.30: Analysis maps menu.

Analysis maps are georeferenced raster (geo-tiff) maps which were taken from Odunpazarı Municipality (Odunpazarı CDP) and optionally can be opened under the vector data. At the same time, analysis maps can be opened as an image (jpeg) file in new browser window and can be seen more detailed.

Seventh and last title on the menu bar is the legend that includes border colours and fill colours of the layers in the web-based application (Figure 4.31).



Figure 4.31: Legend.

Sample User Scenario for the use of the Web-Based Application

Owner of a historic and registered building may wish to renew inside the structure or make arrangements inside and outside of the historic building. Through the web application, user can get information from decisions of the conservation development plan. However, citizens cannot reach the sufficient information so citizen should request information from the municipality to find out which regulations are permitted for renewal.

As an example, a registered building was chosen as a sample historical building and information that can be obtained from the application were shown in the stages of the study.

Firstly in such a case, location of the building is determined by querying lot and lot number using application. Then, buildings features, land registry information and related sheets (registration sheet, etc.) are examined by Municipality. They also review the conservation development plan and given decisions. Moreover, they examine documents such as land registry sheets, building licence, petitions,

correspondences between institutions, etc. Municipality examines the relationship between the building and its surroundings. Then, municipality gets Conservation Council’s opinion and together they give a decision. At the end of the process, municipality informs given decision to property owner. These processes are described below.

In the lower middle panel of the web page interface, information and archive documents panel is located. In the information tab, there are five sub-titles which contain information about vector objects (parcels, buildings). Sub-titles are; parcel information, zoning status, building information, structure information and land registry information.

First sub-title is lot information and contains neighbourhood name, section number, plot number and lot number (Figure 4.32). Third sub-title is building information (Figure 4.33) that contains neighbourhood, street, building number, name, ground floor usage, current building regulation, current floor number and ownership.

▼ Parsel Bilgisi	
Mahalle	PAŞA MAHALLESİ
Pafta No	A4
Ada No	52
Parsel No	13

Figure 4.32: Lot information tab in the information panel.

▼ Bina Bilgisi	
Mahalle	PAŞA MAHALLESİ
Sokak	KEMAL ZEYTİNOĞLU CAD.
Kapı No	48
Adı	-
Zemin Kat Kullanımı	Ticaret
Mevcut Yapı Nizamı	İki Taraftan Bitişik
Mevcut Kat/Yükseklik	3
Mülkiyet	Özel

Figure 4.33: Building information tab in the information panel.

Fourth sub-title of the information panel is structure information (Figure 4.34) that contains registration status, registration date registration sheet, inventory (registration) number, construction period, carrier system, “*building information form / yapı bilgi föyü*”, “*current status sheet / mevcut durum paftası*” and “*building decisions sheets / yapı kararları paftası*”. Registration sheet, building information form, current status sheet and structure decisions sheet are “.pdf” document files.

▼ Yapı Bilgisi	
Tescil Durumu	Tescilli Yapı
Tescil Tarihi	-
Tescil Fişi	Göster
Envanter No	42
Yapı Dönemi	1A
Onarım Durumu	Onarım Görmüş Yapı
Taşıyıcı Sistem	Betonarme Karkas
Yapı Bilgi Föyü	Göster
Yapı Karar Paftası	Göster
Mevcut Durum Paftası	Göster

Figure 4.34: Structure information tab in the information panel.

Registration sheets are pdf documents that contain different types of information about registered building and visual aids such as a photograph of the building, location of the building in the conservation area (Figure 4.35).

Figure 4.35: Registration sheet of the registered building.

Building information forms are pdf documents that come from site survey studies. These sheets contain different types of information about building which were collected in land survey process and visual aids such as a photograph of the building, location of the building in the site plan (Figure 4.36).

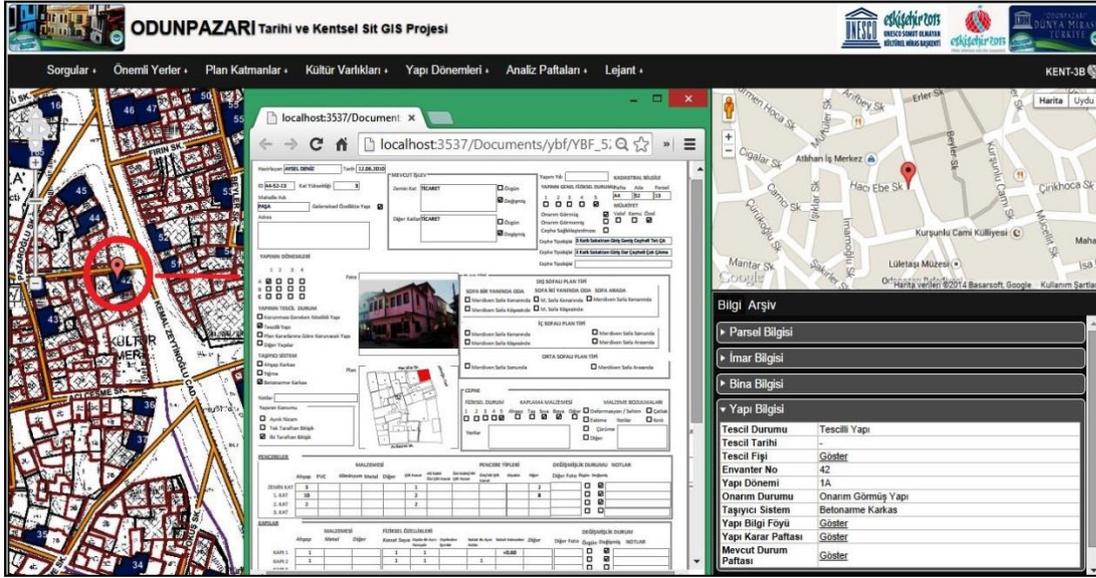


Figure 4.36: “Building Information Form / Yapı Bilgi Föyü” of the registered building.

“Current Status Sheet / Mevcut Durum Paftaları” are pdf file documents. They include parcel information, facade drawings and facade pictures (Figure 4.37).

“Building Decisions Sheet / Yapı Kararları Paftaları” are also pdf file documents. They provide parcel information, current facade drawings and also show future height and area decisions of buildings and empty parcels (Figure 4.38).

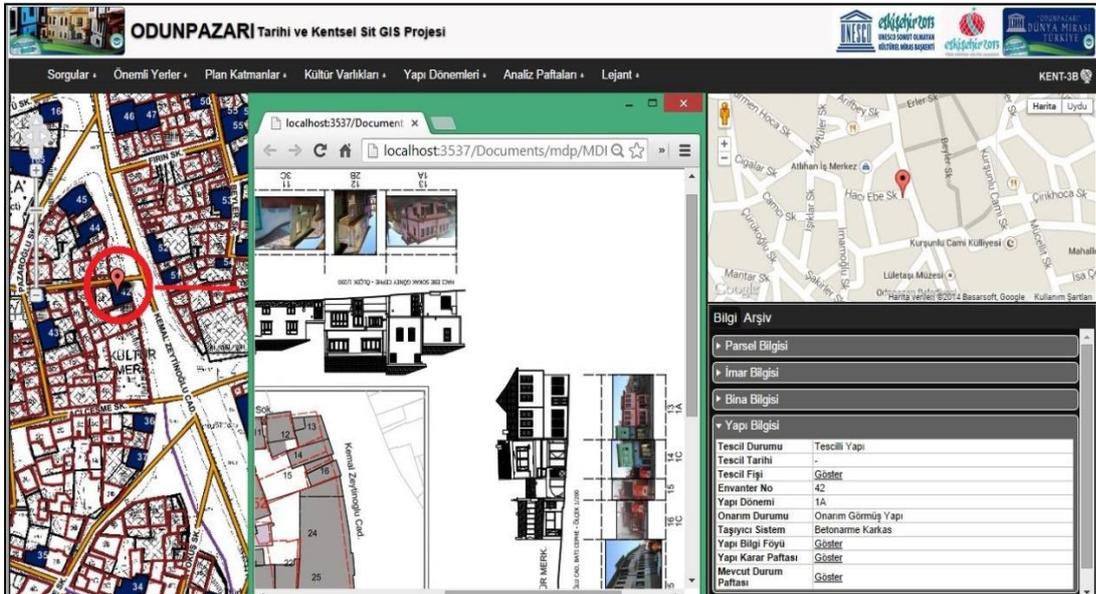


Figure 4.37: “Current Status Sheet / Mevcut Durum Paftası” of the registered building.

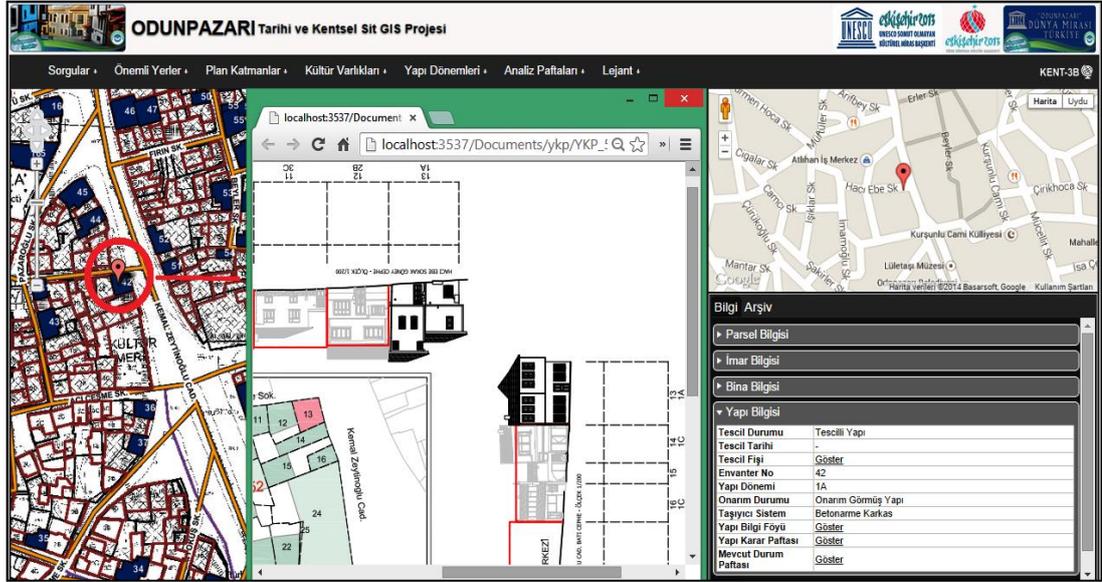


Figure 4.38: “Building Decisions Sheet / Yapı Kararları Paftası” of the registered building.

Fifth and last sub-title is land register information and contains real estate’s owner, real estates’ area, proportion of shares, real estate’s type and acquisition date (Figure 4.39). All these information is coming from related access database file. Relationship between land registration information access database and vector data is described in C# (veritabani.cs) and JavaScript (op.js) files. Relationship has been established with the lot layer. Relationship has been built with parcel layer over neighbourhood name and lot number. Neighbourhood name was added to the relation for the situation of having same lot number in more than one neighbourhood.

Tapu Bilgileri	
Mal Sahibi	AYLA ÇAPAR
Alanı	72.14
Hisse Oranı	1/2
Cinsi	Arsa
Edinme Tarihi	05.08.1999 00:00:00
Mal Sahibi	HASAN ÇAPAR
Alanı	72.14
Hisse Oranı	1/2
Cinsi	Arsa
Edinme Tarihi	05.08.1999 00:00:00

Figure 4.39: Land registry tab in the information panel.

In the fifth and last part of the web page interface, next to the information panel, there is a document archive panel that contains documents in three archive categories; documents about the building construction rights, historical documents and visual documents.

In the documents about the building construction rights tab, there are eighteen sub-titles about scanned documents. By clicking document numbers near the sub-title opens the document in new web browser tab (Figure 4. 40). In historical documents, there are two sub-titles; stories about buildings from people living in there before and promotional texts. Also in visual documents, there are two sub-titles; photographs and videos of buildings.

▼ İmar	
Dilekçe	1 2 3 4 5 6 7 8 9 10
Tapu	1 2
İmar Çapı	
Numarataj Yazısı	1 2
Cephe Onayı	
Yapı Bilgi Formu	1 2
Harç	1 2
İlk Taksit Makbuzu	1 2
Sığınak Raporu	
Mimari Projesi	1 2 3 4 5
Statik Projesi	
Kat Mülkiyeti	
Mimari Tadilat	
Ruhsat	1 2
Tüm Proje	
İskan	
Sit Alanı	
Kurul Yazışmaları	1 2 3 4 5 6

Figure 4.40: Documents about the building construction rights in the archive panel.

Related documents are maintained within certain folders in the project (Figure 4. 41 - 4.42). They are displayed from the certain folders that associated with vector data according to related information (address, lot number, etc.).

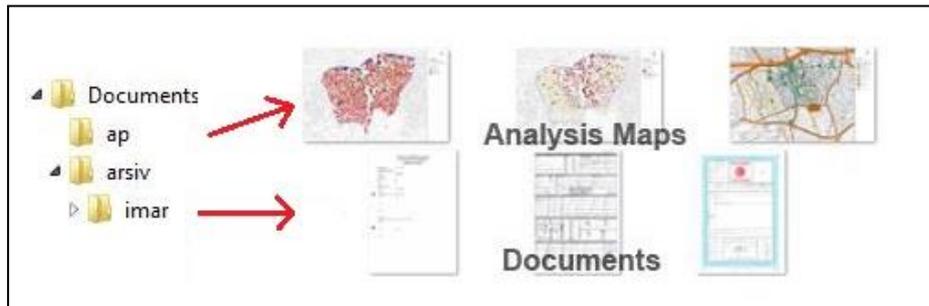


Figure 4.41: Folder structures of related documents.

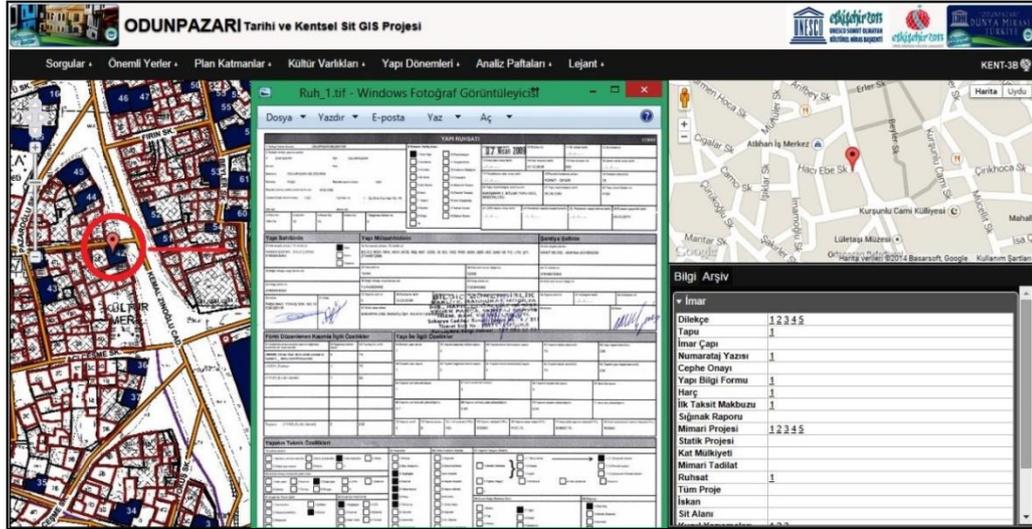


Figure 4.42: Building licence (archive document) of the registered building.

User Groups and Web-based Application Interfaces

There are three user groups described, so three websites were defined for each user group. Web-based GIS applications interface and user capabilities and constraints are described differently from each other according to needs of users. The aim of the designing various application interfaces is to prevent users to access non-authorized information and provide as much information as necessary.

Odunpazarı Municipality employees and Eskişehir Regional Conservation Council of Cultural Properties employees get involved in first user group, and their web-based GIS application is the most talented application and has the most effective capabilities (Figure 4.43).

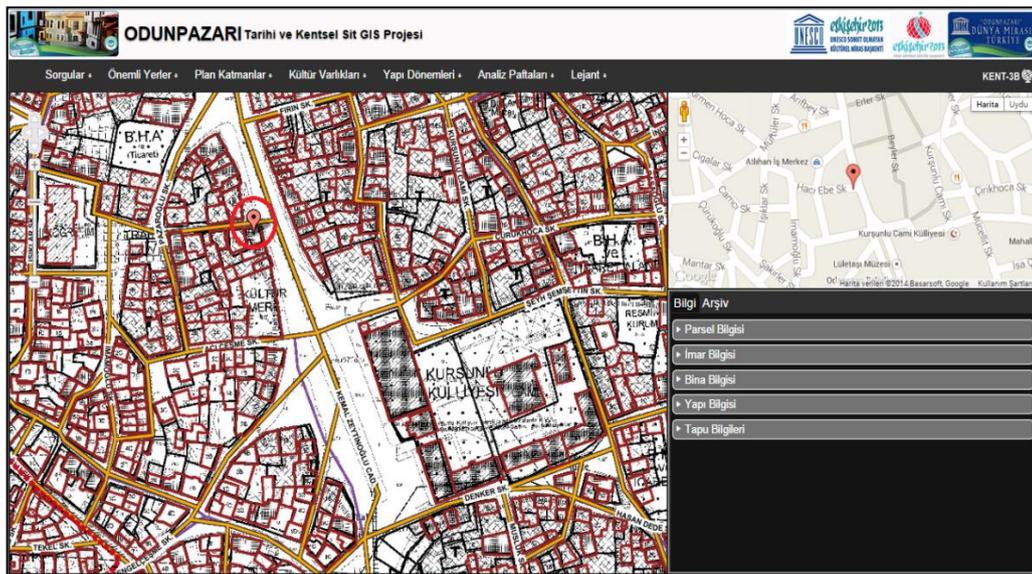


Figure 4.43: Web-based GIS application web site for decision-makers.

First user group (decision-makers) will use web-based GIS application primarily to make new revisions on the development plan from time to time or to make new development plans. Municipalities have to reply petitions that come from citizens living in conservation area. They also have to respond citizens' requests, and answer their questions. At first, they need to find the related structure and its parcel and look at the earlier correspondences, analysis made and decisions given. On the other hand, Eskişehir Regional Conservation Council of Cultural Properties examines the decision given, approves revisions of conservation development plan, and decides on the registration status of structures. With web-based GIS technology, they can look all these necessary data in a single place and respond more quickly. In other words, this user group will make new decisions using obtained information about the structures, analysis and other related documents with the help of web-based GIS application. They are the most authorized user group, so they will use the application without any constraint.

The inhabitants of Odunpazarı, effected by given decisions about urban site area, get involved in second user group (Figure 4.44). People incoming for touristic purposes gets involved in third user group (Figure 4.45).

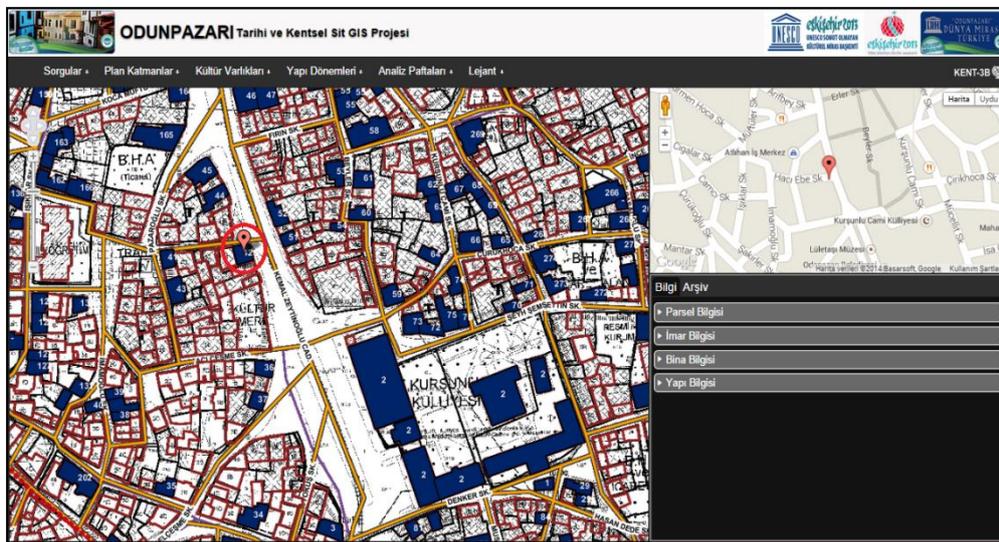


Figure 4.44: Web-based GIS application web site for other stakeholders.

Second user group (stakeholders) which consist of citizens, related chambers, civil society organizations and relevant departments of universities will use web-based GIS application to get information about decisions given and prepared conservation development plan. According to the decision given, they may contest the decisions

given or make new requests. They can get information about possible interventions can be done to buildings. In the case of demolishing a structure and building a new one, they can obtain how many floors can be made of the new structure. This user group is one of the participants in decision-making process but not one of the decision-makers. They can see details about structures within specific limits. They can't see customized queries, land register or archive documents.

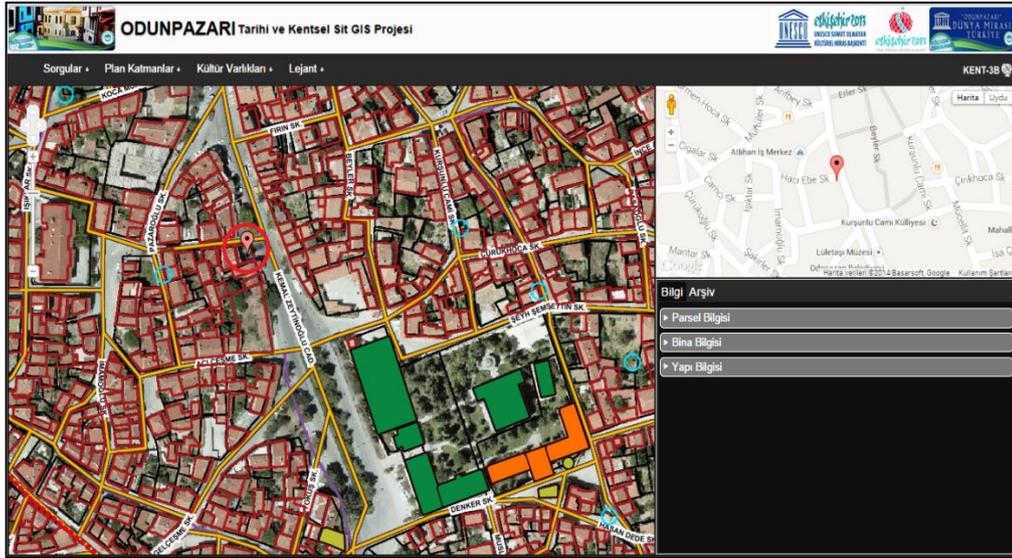


Figure 4.45: Web-based GIS application web site for visitors.

Last user group that application developed for is the tourists. Tourists are the people who want to visit Odunpazarı to see the historic settlement/structures. Before visiting the conservation area (historic settlement), they can get detailed information about registered and restored structures by using web-based application. They can obtain information about the location of the buildings with maps. They can determine a route for visiting the area. They can also look at the visual and historical archive files for more information. This user group has quite limited capabilities; they can see only basic features in the web interface.

4.4 Codes for developing Web-based GIS Application

In “*Veritabani.cs*” file, table of land registry records in MS Access database was associated with spatial (vector) data on neighborhood and parcel number.

```
public static class Veritabani
{
    public static DataTable GetTapuKayit(string ada, string parsel, string mahalle)
    {
        StringBuilder sql = new StringBuilder();
        sql.Append("SELECT * FROM TapuKaydi WHERE Ada=@ada AND Parsel=@parsel AND MahalleAdi=@mahalle");

        OleDbManager db = new OleDbManager();
        db.Parameters.Add("@ada", Convert.ToInt32(ada));
        db.Parameters.Add("@parsel", Convert.ToInt32(parsel));
        db.Parameters.Add("@mahalle", mahalle);

        return db.GetTable(sql.ToString());
    }
}
```

Figure 4.46: Veritabani.cs codes associating Access database with spatial data.

In “*oleDbManager.cs*” file, connection string of related database was defined. Associated OLE DB type, name and folder location of the database were specified.

```
public OleDbManager()
{
    string dir = HttpContext.Current.Server.MapPath("~/Data");

    StringBuilder connectionString = new StringBuilder();
    connectionString.Append("Provider=Microsoft.ACE.OLEDB.12.0;Data Source=");
    connectionString.Append(dir);
    connectionString.Append("\\\\VERITABANI.accdb;Persist Security Info=False;");
    this.Connection = new OleDbConnection(connectionString.ToString());
}
```

Figure 4.47: oleDbManager.cs codes describing Access database connection.

In “*Postgis.cs*” file, data tables of the queries were defined with sql query strings (Figure 4.48). Spatial data layers within PostgreSQL were defined (Figure 4.49).

```
public static class Postgis
{
    public static DataTable GetAdalar()
    {
        string sql = "SELECT DISTINCT ada FROM op_sit_PARSELLER_Polygons
WHERE ada<>' ORDER BY ada ASC";

        PostgreSQLDbManager db = new PostgreSQLDbManager();

        return db.GetTable(sql);
    }

    public static DataTable GetParsellerByAda(string ada)
    {
        string sql = "SELECT DISTINCT parsel FROM op_sit_PARSELLER_Polygons
WHERE parsel<>' AND ada=@ada ORDER BY parsel ASC";

        PostgreSQLDbManager db = new PostgreSQLDbManager();
        db.Parameters.Add("@ada", ada);
        return db.GetTable(sql);
    }
}
```

Figure 4.48: Postgis.cs codes defining spatial data tables.

```

public static string GetParselBBox(string gid)
{
    string sql = GetBBoxScript("op_sit_PARSESELLER_Polygons", "gid=@gid");

    PostgreSqlDbManager db = new PostgreSqlDbManager();
    db.Parameters.Add("@gid", gid);

    DataTable dt = db.GetTable(sql);

    if (dt.Rows.Count > 0)
        return dt.Rows[0]["bbox"].ToString();

    return null;
}

```

Figure 4.49: Postgis.cs codes defining bbox strings of spatial data tables.

In “*proj4js-epsg2320.js*” file, projection of the project (EPSG:2320) was defined.

```

Proj4js.defs["EPSG:2320"] = "+proj=tmerc +lat_0=0 +lon_0=30 +k=1 +x_0=500000 +y_0=0 +ellps=intl +units=m +no_defs";

```

Figure 4.50 proj4js-epsg2320.js codes defining projection of the project.

In “*op.js*” file, longitude-latitude values of the project’s location and WMS URL of the spatial data that comes from GeoServer was defined. Transformations between positions and geo-positions of map data (OpenLayers and Google map) were defined. Coordinate and projection unity (WGS84) between OpenLayers map and Google map has been achieved with these transformations (Figure 4.51). Feature info (create and initialize) functions were defined.

```

Convert: {
    toPosition: function (geoposition) {
        return new OpenLayers.LonLat(geoposition.lon, geoposition.lat).transform(
            new OpenLayers.Projection('WGS84'), new OpenLayers.Projection(
                op.Controls.OpenLayersMap.epsg));
    },
    toPositionEx: function (geoposition) {
        var position = op.Convert.toPosition(geoposition);
        return new OpenLayers.LonLat(position.lon + op.Globals.locationEx.lon,
            position.lat + op.Globals.locationEx.lat);
    },
    toGeoposition: function (position) {
        return new OpenLayers.LonLat(position.lon, position.lat).transform(new
            OpenLayers.Projection(op.Controls.OpenLayersMap.epsg), new OpenLayers.Projection(
                'WGS84'));
    },
    toGeopositionEx: function (position) {
        return new OpenLayers.LonLat(position.lon - op.Globals.locationEx.lon,
            position.lat - op.Globals.locationEx.lat).transform(new OpenLayers.Projection(
                op.Controls.OpenLayersMap.epsg), new OpenLayers.Projection('WGS84'));
    }
},

```

Figure 4.51: op.js codes defining transformations between positions.

OpenLayers map settings and properties were set. Vector and raster data within the OpenLayers were added to project as WMS single tiles (Figure 4.52). Min-Max zoom levels and displaying options of the layers were described.

```

getLayers: function () {
    return {
        imar_plani: new OpenLayers.Layer.WMS("imar_plani",
op.Globals.wmsUrl,
            { layers: 'op:op_imar_plani_raster', format:
'image/gif', transparent: 'true' },
            { singleTile: true })),
        parseller: new OpenLayers.Layer.WMS("parseller",
op.Globals.wmsUrl,
            { layers: 'op:op_sit_parseller_polygons', format:
'image/gif', transparent: 'true' },
            { singleTile: true })),
    };
}

```

Figure 4.52: op.js codes defining OpenLayers get layer (WMS) functions.

GetFeatureInfo function, that used for getting information about visible layers by clicking on the map using coordinate values, was described (Figure 4.53). Google Map settings and functions (setLocation, initialize) were set (Figure 4.54). Web service and data service functions were set.

```

getFeatureInfo: function (e) {
    $('#featureInfoContent').html('');
    $('#arsivContent').html('');
    var qlayers = '';
    for (var key in op.Controls.OpenLayersMap.map.layers) {
        if (op.Controls.OpenLayersMap.map.layers[key].visibility) {
            if (op.Controls.OpenLayersMap.map.layers[key].params != null)
            {
                if (qlayers != '') { qlayers = qlayers + ','; }
                qlayers = qlayers + op.Controls.OpenLayersMap.map.layers
[key].params.LAYERS;
            }
        }
    }
    e.xy.x = parseInt(e.xy.x);
    e.xy.y = parseInt(e.xy.y);
    op.Globals.dataSrv.getFeatureInfo
(op.Controls.OpenLayersMap.map.getExtent().toBBOX(), e.xy.x, e.xy.y, 'application/
vnd.ogc.gml', qlayers, qlayers, 50, op.Controls.OpenLayersMap.epsg, "",
op.Controls.OpenLayersMap.map.size.w, op.Controls.OpenLayersMap.map.size.h,
    function (result){...}, function (error) { });
}

```

Figure 4.53: op.js codes describing GetFeatureInfo function.

```

GoogleMap: {
  ctrlId: 'gmap',
  map: null,
  marker: null,
  location: null,
  setLocation: function (geoposition) {},
  setMarkerLocation: function (geoposition) {},
  initialize: function (geoposition) {
    op.Controls.GoogleMap.location = new GLatLng(geoposition.lat,
geoposition.lon);
    op.Controls.GoogleMap.map = new GMap2(document.getElementById
(op.Controls.GoogleMap.ctrlId));
    op.Controls.GoogleMap.map.setCenter(op.Controls.GoogleMap.location,
17);

    op.Controls.GoogleMap.map.setUIToDefault();
    op.Controls.GoogleMap.setMarkerLocation(geoposition);
    GEvent.addListener(op.Controls.GoogleMap.map, 'click', function
  },
},

```

Figure 4.54: op.js codes defining Google Map settings.

Functions, related with queries and layers displaying options situated in the application interface, were defined (Figure 4.55). Initialize (click) functions of the queries, Google Map and OpenLayers Map were defined (Figure 4.56).

```

DataService: function () {
  var srv = new op.Services.WebService('Services/DataService.asmx');
  this.listAdalar = function (resultFunction, errorFunction) {
    srv.execute('ListAdalar', null, resultFunction, errorFunction);
  };
  this.getParselBBBox = function (gid, resultFunction, errorFunction) {
    var prms = { gid: gid };
    srv.execute('GetParselBBBox', prms, resultFunction, errorFunction);
  };
  this.getFeatureInfo = function (bbox, x, y, infoFormat, queryLayers,
layers, featureCount, srs, styles, width, height, resultFunction, errorFunction) {
    var prms = { bbox: bbox, x: x, y: y, infoFormat: infoFormat,
queryLayers: queryLayers.toString(), layers: layers.toString(), featureCount:
featureCount.toString(), srs: srs, styles: styles, width: width.toString(), height:
height.toString() };
    srv.execute('GetFeatureInfo', prms, resultFunction, errorFunction);
  };
  this.getTapuKayitByAdaAndParsel = function (ada, parsel, mahalle,
resultFunction, errorFunction) {
    var prms = { ada: ada, parsel: parsel, mahalle: mahalle };
    srv.execute('GetTapuKayitByAdaAndParsel', prms, resultFunction,
errorFunction);
  };
  this.getArsivKayit = function (ada, parsel, resultFunction, errorFunction)
{
    var prms = { ada: ada, parsel: parsel };
    srv.execute('GetArsivKayit', prms, resultFunction, errorFunction);
  };
  this.listBinaOzelikByTurAndDeger = function (tur, deger, resultFunction,

```

Figure 4.55: op.js codes describing data service (query, display) functions.

```

initialize: function () {
    op.Globals.dataSrv = new op.Services.DataService();
    $('#lnkAdaParselSorgula').click(function ()...);
    $('#lnkAdresSorgula').click(function ()...);
    $('#lnkOnemliYerSorgula').click(function ()...);
    $('#lnkTescilNoSorgula').click(function ()...);
    $('#lnkBinaOzellikSorgula').click(function ()...);
    $('#lnkGMap').click(function () { op.Controls.TabCtrl.showItem(0); });
    $('#lnkInfo').click(function () { op.Controls.TabCtrl.showItem(1); });
    $('#lnkDocument').click(function () { op.Controls.TabCtrl.showItem(2); });
    $('.layer').change(function ()...);
    $('#checkboxYD_Tumu').change(function ()...);
    op.Controls.TabCtrl.showItem(1);
    op.Controls.OpenLayersMap.initialize();
}

```

Figure 4.56: op.js codes defining initialize functions.

In “*DataService.asmx.cs*” file, Web methods of queries, layers displaying options, getting feature info, archive files and land registrations were described (Figure 4.57).

```

public class DataService : System.Web.Services.WebService
{
    [WebMethod]
    public string ListAdalar()
    {
        DataTable dt = Postgis.GetAdalar();
        return HtmlContent.CreateSelectItems(dt);
    }

    [WebMethod]
    public string GetTescilliYapiBBox(string gid)...

    [WebMethod]
    public string ListOnemliYerler(string tur, string mahalle, string sokak)
    {
        DataTable dt = Postgis.GetOnemliYerler(tur, mahalle, sokak);
        return HtmlContent.CreateOnemliYerlerTable(dt);
    }

    [WebMethod]
    public string GetFeatureInfo(string bbox, string x, string y, string
infoFormat, string queryLayers, string layers,
                                string featureCount, string srs, string styles,
string width, string height)...

    protected string CreateArsivRow(string ada, string parsel, string rootNode,
string[] childrenNodes)...

    [WebMethod]
    public string GetArsivKayit(string ada, string parsel)...

    [WebMethod]
    public string GetTapuKayitByAdaAndParsel(string ada, string parsel, string
mahalle)...

```

Figure 4.57: DataService.asmx.cs codes describing web methods of the study.

In “*Default.aspx*” file, Java scripts and css files that run on the project were specified (Figure 4.58). Menu tabs of the application interface were described (Figure 4.59).

```

<head runat="server">
  <title>Ođunpazarı Kentsel Sit GIS Projesi</title>
  <link href="Styles/op.css" rel="stylesheet" />
  <link href="Theme/default/style.css" rel="stylesheet" />
  <script src="Scripts/jquery-1.7.2.min.js"></script>
  <script src="Scripts/jquery-ui-1.8.18.custom.min.js"></script>
  <script src="Scripts/jquery.json-2.3.min.js"></script>
  <script src="Scripts/OpenLayers.js"></script>
  <script src="Scripts/proj4js-compressed.js"></script>
  <script src="Scripts/proj4js-epsg2320.js"></script>
  <script type="text/javascript" src="http://maps.google.com/maps?
file=api&v=2&sensor=false&key="></script>
  <script src="Scripts/op.js"></script>
  <script type="text/javascript">
    jQuery(document).ready(function () {
      op.Globals.wmsUrl = '<%=ConfigurationManager.AppSettings["geoServerUrl"]%>';
      op.initialize();
    });
  </script>
</head>

```

Figure 4.58: Default.aspx codes defining scripts involved in the study.

```

<ul class="mainmenu">
  <li class="mainmenu-menu"><a href="#">Sorgular</a>
    <ul>
      <li><a id="lnkAdaParselSorgula" href="#">Ada Parsel</a></li>
      <li><a id="lnkAdresSorgula" href="#">Adres</a></li>
      <li><a id="lnkOnemliYerSorgula" href="#">Önemli Yer</a></li>
      <li><a id="lnkTescilNoSorgula" href="#">Tescil No</a></li>
      <li><a id="lnkBinaOzellikSorgula" href="#">Yapı Özellikleri</a></li>
    </ul>
  </li>
  <li class="mainmenu-menu"><a href="#">Önemli Yerler</a>
    <ul>...</ul>
  </li>

```

Figure 4.59: Default.aspx codes defining main menu elements of the study.

In “*Web.config*” file, WMS URL of the spatial data that comes from GeoServer (Figure 4.60). PostgreSQL connection properties were described for spatial map data (Figure 4.61).

```

<appSettings>
  <!--GeoServer wms url-->
  <add key="geoServerUrl" value="http://localhost:8080/geoserver/op/wms"/>
</appSettings>

```

Figure 4.60: Web.config codes describing GeoServer WMS Url.

```

<connectionStrings>
  <add name="postgreSqlConn" connectionString="Server=localhost; Port=5432;
User Id=postgres; Password=admn; Database=opazari;"/>
</connectionStrings>

```

Figure 4.61: Web.config codes describing PostgreSQL connection properties.

4.5 Results & Discussion

In this study, an improved database and a web-based urban conservation tool were designed. At the beginning of the study, a well-designed and powerful database is designed for the web-based urban conservation tool. Original database is a single table design database and it has more than one hundred columns. It has an unsuitable design for using in web-based application. So, it was redesigned for better and faster database query performance. In this improved database, different kinds of data, databases and sheets taken from different institutions were located.

Server side architecture was chosen as Web-based GIS system architecture type, and system is designed through server side architecture. Different kinds of programs and technologies, mostly open source, were used for the study. Microsoft IIS was used as Web Server. Geoserver was used as Map/Application Server and PostgreSQL was used as Database Server.

As compared to other studies, thanks to Odunpazarı CDP studies, a large variety of data have been reached. After web-based application designed, vector data and attribute data about structures in the conservation area (parcels, buildings, registered buildings, streets, etc.), geo-referenced raster maps (satellite photograph, aerial photograph, conservation development plan, etc.), deed information (database), sheets (Registration Sheets, “*Current Status Sheets*”, etc.), scanned archive documents, photos/videos and historical notes about buildings were integrated with Web-Based GIS application. Data integrity from different institutions was provided.

In the CDP, various studies such as field studies and data collection, data analysis and creating conservation development plans were performed for urban conservation studies. However, obtained information and valuable data cannot be used efficiently enough, if they used separately. It is necessary to integrate various kinds of data within an improved centralized system. This requirement can be solved with an advanced database structure and a web-based GIS technology.

The main purpose of this study is to improve a new well-designed database design and a web-based urban conservation tool that can serve different user groups and easily accessible for urban conservation studies which need various types of data and a multiple stakeholder process. An improved database which has an improved query

performance and a new web-based application/tool were needed for integrating various types of data and serving different user groups. Decision-maker institutions need to access different types of data and make customized queries in a quick and easy way to make decisions. As a solution to these needs, an improved database and a web-based urban conservation tool/application were designed. This study will become a reference for future studies.

The improved and well-designed database design provides;

- More simple and regular database
- Better defined tables and well-established relationships between tables
- Better and faster database query performance
- A database which land register information is integrated
- A database which related sheets (registration sheet, etc.) are integrated

Web-based Urban Conservation Tool (GIS application) provides;

- Systematic overview of all related information about conserved area and traditional buildings,
- Dynamic and flexible database structure in order to answer various evaluations criteria and queries of end users,
- Faster, precise and widespread distribution of related data to different user groups by using the internet.

CHAPTER 5

CONCLUSION

5.1. Conclusion

Briefly in the thesis, firstly literature about urban conservation, GIS and Web-based GIS technologies, architectures and components of Web-based GIS and earlier studies were reviewed. Then, an improved database was designed and different kinds of data (vector data, databases and sheets) were embedded into the newly designed database. Query performance measurements of original database and designed database were discussed. Structures information, land registry information and related sheets were integrated into a single well-designed database. After that, a web-based urban conservation tool was developed as server-side architecture by using mostly open source software. The improved database, geo-referenced raster maps (satellite photograph, aerial photograph, conservation aimed development plan, analysis maps etc.), scanned archive documents, photos/videos and historical notes about structures were integrated with Web-Based GIS application.

It has been observed that, improved database is better and faster in database queries. It is more simple and regular than the original database and it has well-defined data tables and well-established relationships between tables. Moreover, developed web-based urban conservation tool is a very useful and user-friendly application about bringing different kinds of data in a single system and sharing data with different user groups (stakeholders) over the internet.

With all these features, the improved database design and the web-based urban conservation tool have become good references for future studies. Similar studies should be continued in order to ensure cultural continuity.

5.2. Recommendation

The improved database design and the designed web-based urban conservation tool could be a well-guiding example and an introductory model for developing a more advanced and detailed models in the future.

It is recommended to choosing server-side architecture as the web-based applications architecture and the use of open source software in the design and usage of the web-based application. Server-side architecture is simpler to develop, easier to deploy and easier to maintain. Moreover, open source programs give users the freedom to run the program for any purpose, to modify the program, and to freely redistribute program without further limitations or royalty payments.

In web-based GIS application of the study, vector data and databases are kept on the server and data can only be changed within the server. In future works, data can be arranged even over the Internet.

Also in future works, 360 Degree Virtual Tour of Odunpazarı can be integrated into web application. People can walk around the city via the web application.

Moreover, using the projected metric coordinates of the buildings, the contiguity conditions of the buildings can be detected. The contiguity can be detected by calculating distances between the buildings that located in the same street using their coordinates and counting building numbers which are closer than ten meters. Studies can be done about this subject in future.

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APPENDIX A

SHEETS AND LAYOUTS WITHIN THE WEB-BASED URBAN CONSERVATION TOOL

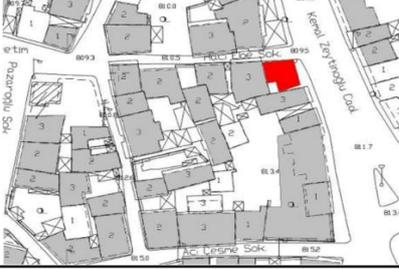
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Figure A.1: Registration Sheet of the registered building

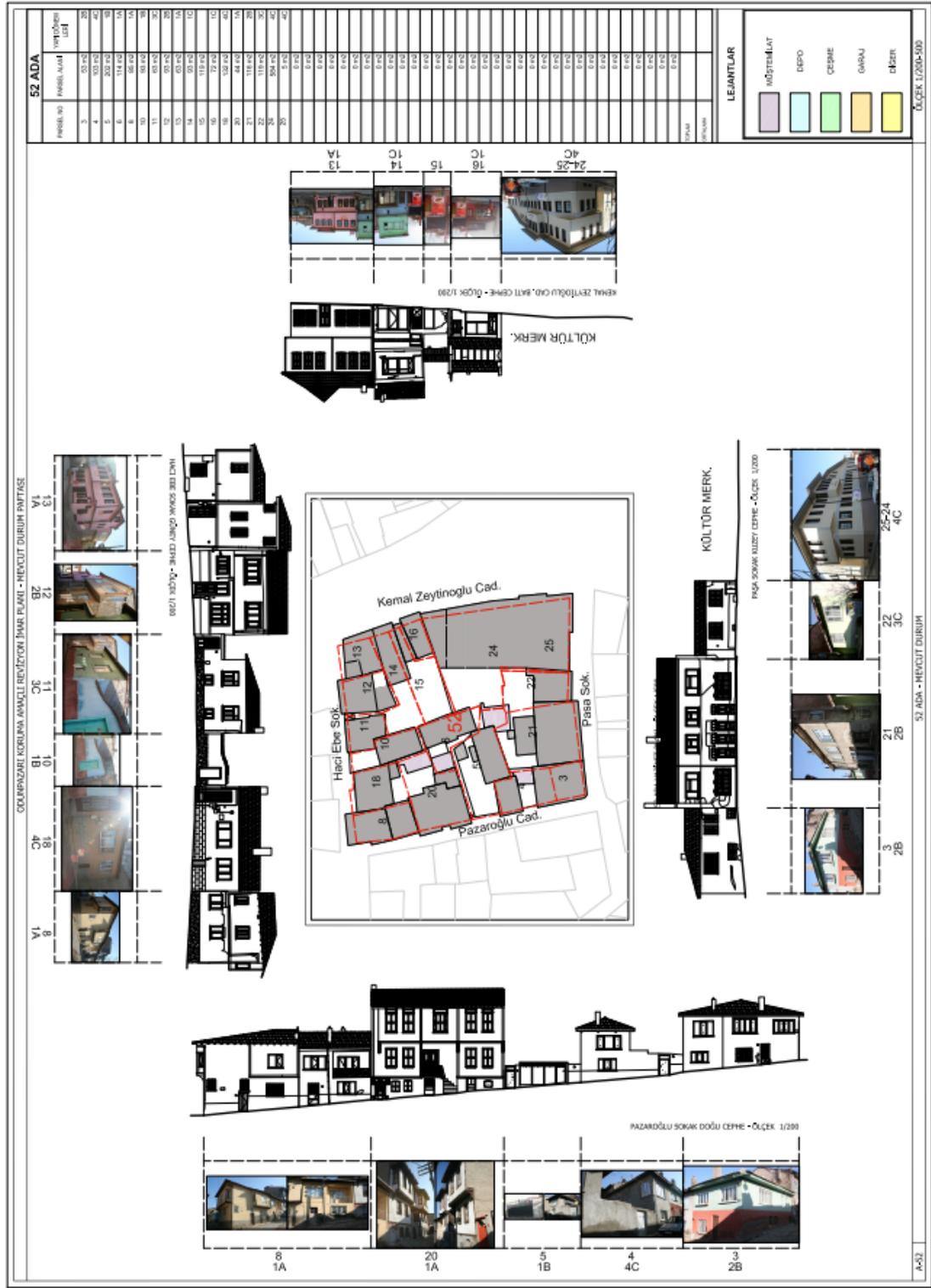


Figure A.3 Current Status Sheet of the registered building.
(Özkut and Yılmaz, 2011)

