Design and development of a web GIS for management and performance evaluation of agricultural farms of sahar food industries company (SFIC)

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Abstract. The web has changed everything, and GIS is no exception. Web GIS, as a combination of web and Geospatial information system or science (GIS) has become an evolving discipline. Web GIS provides all GIS functions, including easy access to spatial information, display, storage, editing, management, manipulation, analysis, and sharing of spatial information anywhere in the world at a relatively low cost and easily for end users. Has accepted. In this article, we will discuss the key technology of digital spatial information management system (Web GIS) of digital farms, then we will introduce SFIC. Finally, we design and develop a Web GIS as a management system with the aim of providing a suitable platform for the realization of visual management performance and also evaluating the performance of agricultural farms. This management and monitoring system helps decision makers and professionals to easily make appropriate decisions to increase crop production, management, updating spatial and descriptive farm information, and other related activities. Sahar Web GIS Agricultural Farm Management Spatial Information System helps ordinary and non-expert users to easily access information and improves the necessary measures for making decisions in this field.

1. Introduction
By common definition, GIS is a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the Earth [1, 2]. Internationally, GIS was used in agriculture in the 1970s. This science is used in the study of land resources, land resource evaluation, agricultural resource management analysis. Since 1990, the application of GIS in agriculture has deepened and expanded [3]. With the development of World Wide Web technology in the early 1990s, people began to integrate WEB technology with GIS technology to shape Web GIS. The integration of the Internet and the Web and traditional disciplines has created many new things, and Web GIS is one of them. Web GIS has evolved rapidly since 1993 [4].

Since the agricultural industry is one of the main pillars of Iran's economy, it can be said that the country's economic growth is almost impossible without agricultural growth and development. In this regard, SFIC as a food industry company with the management of about 100 hectares of agricultural farms with various products in several provinces of Iran, has been operating as a leading company in the food industry since 1991 in the field of food production. Therefore, due to the dispersion of farms across the country and the challenge in efficient and optimal management as well as improving
agricultural production, we have designed and developed a system for sharing spatial and descriptive data, updating information, predicting results, improving business practices and evaluating the performance of agricultural farms. Web GIS technology provides an individualized perspective on agricultural-related activities, including greater productivity through automation, greater access to information, support, and clearer decision-making and policy insights [5-7].

2. Methods
In this study, to start work, 34 agricultural farms under the management of SFIC with an area under cultivation is about 100 hectares as preliminary spatial data obtained from fieldwork, including X and Y coordinates of farmland lands obtained from land surveying using GPS Garmin 64S in Khuzestan and Ardabil provinces and also descriptive farm information in the form of paper and electronic documents obtained from SFIC Agricultural Research Center. After collecting from the desired section, it was arranged in an integrated manner. Spatially and Descriptive Database Layer Structure is shown in Figure 1.

![Figure 1. Spatially and Descriptive Database Layer Structure](image)

The GIS Web Farm Management System has been developed for easy access by non-specialist users with minimal knowledge of Geospatial Information System (GIS) and has attempted to design and develop products based on Arc GIS technology. It consists of three main components: data, servers and applications [8].

Data Tier: This section includes the database management system and manages all farm data including spatial and descriptive information. Here metadata information is stored and retrieved. The database management system, which is responsible for managing data updates, allows multiple users to access web servers simultaneously, ensures security, data integrity, and most importantly, the speed and flexibility of the platform's database. Web GIS using a Microsoft SQL Relationship Database Management System (RDBMS) supported by ArcGIS 10.3. The organizational database includes storage, management, data attribute definitions, multi-user transaction processing, and complex database query processing. In Arc SDE, ArcGIS 10.3 was integrated into both ArcGIS Desktop and ArcGIS Server and is now officially known as Arc SDE technology. Arc SDE, as a gateway between GIS and RDBMS clients, provides spatial data and enables data access and management in RDBMS [8].

Logical Tier: The GIS server is the most important component in Web GIS. Spatial functions, personalization, scaling, and performance are the most important characteristics of the success of a Web GIS application. The performance and quality of a Web GIS application are measured by its GIS server.

Presentation Tier: This section is responsible for communication and interaction with the user. And its purpose is to design a user-friendly and efficient interface for interaction and communication with the user. For example, users of this system can easily access the Internet using web browsers in the mobile and desktop sections. In this system, Hypertext Markup Language (HTML) is used to structure the content of the web page, Cascading Style Sheets (CSS) to make the web page beautiful and enlivened,
and from JavaScript as a web-side programming language for dynamics. We have taken advantage of the dynamics and motion sensitivity of web pages [4,8,9].

The basic architecture used in this Web GIS is similar to web applications to which GIS components have been added. In a workflow, the user uses the Web GIS application on the client side, which can be under a web browser, desktop application or mobile application. The user sends his request over the Internet via HTTP to the web server. The web server sends the GIS request to the GIS server. The GIS server retrieves the required data from the GIS database and examines the request, which can result in generating a map, performing a query, or performing an analysis. Data, maps and other results are sent to the client by the web server via HTTP. The client can show the results to the user, thus ending the request and response cycle. The basic architecture of WebGIS is shown in Figure 2 [4,8,9].

![Figure 2. Architecture of the Web GIS application](image)

Sahar Agricultural Management Web GIS platform with ArcGIS JavaScript API 3.32, is designed and developed as a 2D application. This platform is able to display and use remote sensing in the form of satellite images and digital maps of agricultural farms obtained from the Global Positioning System. Figure 3 shows a brief overview of the capabilities and functions of the Sahar Web GIS platform [8].

![Figure 3. Functionalities of Sahar Agricultural Management Web GIS platform](image)

### 3. Results and Discussion

Sahar web-based spatial information management platform is designed and developed based on (GIS, remote sensing and global positioning system) to achieve the management, monitoring and evaluation of agricultural farms remotely [10]. Has special features such as high-precision remote sensing map display of farm area, management of farm spatial layers, farm type identification guide, display of information about each farm, query, performance evaluation chart, add or Provides editing of spatial and descriptive information of each farm for users of this system.

#### 3.1. Query Task:

Due to the fact that agricultural farms are scattered in several provinces and it will be difficult for the user to search for farms, therefore, the user can search using the query feature based on specific features such as farmer name, city and product type. And then the search results are
displayed on the map and the number of selected features in the Feature Table. Query based on the city for example the city of Shoush and display the farms found on the map as zoom to extent of Selected features, shown in the Figure 4 [11].

Figure 4. Query Task Window

Then display the Query results in the Attribute Table, where 3 fields are found, selected and displayed in the table, shown in the Figure 5.

Figure 5. Farms Attribute Table Window

3.2. Editor Widget: provides out-of-the-box editing capabilities using an editable layer in a Feature Service. Using this capability, the user will be able to create, move, delete the feature also edit feature includes add, delete and move the vertex of polygon border of agricultural farms without the need for basic ArcGIS software only through the web, shown in the Figure 6 [11].
3.3. **Gauge Widget**: provides a streamlined way to create a dashboard-like interface and display data on a semi-circular gauge. This dashboard allows you to display the performance evaluation (efficiency) of agricultural farms (harvest rate (tons per hectare)) in the form of a gauge diagram, shown in Figure 7 [11].

3.4. **Info Template**: Window the ability to quickly display side information of agricultural farms by clicking on each farm is provided for the user, shown in the Figure 8 [11].
Figure 8. Farms Descriptive informations display window

3.5. Measurement Tools: This tools shows how user can to add the Measurement widget to your application. The Measurement widget, provides tools for determining the x,y location and measuring area and distances, shown in the Figure 9 [10,11].

Figure 9. Measure the area of the farm boundary

3.6. Attribute Table: capability, the user will be able to access the information tables that we knew as Attribute Table in ArcGIS Software through this and also the ability to edit Farms descriptive information, Zoom in on the farm by clicking on each row, Sorting and Statistical information about numerical fields such as farm yields (average, sum, maximum, minimum, etc.) in these tables is provided for the user, shown in Figure 10 [11].
4. Conclusion

The evolution of the web and its rapid expansion in recent decades has created a new platform for information sharing with great potential and capabilities, including spatial information, and has increased productivity, speed, efficiency and easy access for users. GIS is no exception to this rule and has taken all the features and capabilities that the user needs in desktop applications out of the traditional way and shared it through the World Wide Web [12]. Sahar spatial information management support system, in this regard, a cost-effective solution through the integration of GIS with the web can be a very good example in sharing and visualizing spatial and descriptive information related to agricultural farms. And will lead to improving the management level of companies affiliated with the food and agricultural industries, promoting the development of advanced technology and digital in the agricultural industry, more widely and effectively. And has improved the field for management and evaluation of agricultural farms by managers, experts and decision makers in this field in a more intuitive way [13-15].

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