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DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

CS/INF 1211 GEOGRAPHICAL INFORMATION SYSTEM

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THEME NO 5

WEB-BASED GEOGRAPHIC INFORMATION SYSTEM FOR MAPPING RECREATIONAL AND SPORTS FACILITIES IN ZANZIBAR

ABSTRACT

Web Geographic Information Systems (Web GIS) have become powerful tools for managing, analyzing and visualizing spatial data through the internet. This project presents the development of a Web-Based Geographic Information System for mapping recreational and sports facilities in Unguja Island, Zanzibar. Recreational and sports facilities play a vital role in promoting physical health, social interaction and community development. However, in many parts of Unguja, information regarding the location, distribution and characteristics of these facilities is poorly documented and not easily accessible to the public or planning authorities.

The project uses spatial data collected from OpenStreetMap and processed using QGIS software. The datasets include administrative boundaries, road networks and point locations of recreational and sports facilities such as stadiums, playgrounds, and sports centers. The spatial data were cleaned, organized and converted into GeoJSON format for use in a web environment. Leaflet.js, an open-source JavaScript library, was used to develop an interactive web map that allows users to visualize facilities, toggle layers and view attribute information through pop-up windows.

The resulting Web GIS application provides an interactive and user-friendly platform for accessing spatial information related to recreational and sports facilities in Unguja. The system can support urban planners, decision-makers, and the general public in identifying facility locations, assessing spatial distribution and improving planning and management of recreational infrastructure. This project demonstrates the practical application of Web GIS technology in addressing real-world spatial problems.

1. INTRODUCTION

Geographic Information Systems (GIS) are widely used tools for capturing, storing, analyzing, and displaying geographically referenced data. Traditionally, GIS applications were limited to desktop environments and required specialized software and technical expertise. With advancements in internet technologies, GIS has evolved into Web-Based GIS, which allows spatial data to be accessed and interacted with through web browsers. Web GIS enhances data sharing, accessibility, and real-time interaction, making spatial information available to a wider range of users.

Recreational and sports facilities are essential components of urban and regional development. These facilities contribute to physical fitness, mental well-being, social cohesion, and youth development. Facilities such as stadiums, playgrounds, football fields, and sports centers provide spaces for organized sports and leisure activities. In regions experiencing rapid urbanization, such as Unguja Island in Zanzibar, the planning and management of recreational infrastructure is increasingly important.

Despite the importance of recreational and sports facilities, information about their spatial distribution in Unguja is often scattered and not centrally available. Residents may struggle to locate nearby facilities, while planners may lack accurate spatial data to assess accessibility and service coverage. Web GIS provides an effective solution by offering interactive maps that integrate spatial data with attribute information.

This project focuses on developing a Web-Based GIS using Leaflet.js to map recreational and sports facilities in Unguja, Zanzibar. The system aims to improve access to spatial information and demonstrate the usefulness of Web GIS technology in supporting planning and decision-making processes.

2. PROBLEM STATEMENT

The availability and accessibility of recreational and sports facilities are critical for promoting healthy lifestyles and social development. In Unguja Island, Zanzibar, recreational and sports facilities exist in various locations; however, there is no centralized and interactive system that provides comprehensive spatial information about these facilities. Information related to facility locations, types, and characteristics is often incomplete, outdated, or difficult to access.

Many residents are unaware of nearby recreational and sports facilities due to the lack of publicly available spatial maps. Urban planners and decision-makers also face challenges in assessing the spatial distribution of facilities and identifying underserved areas. This situation can result in unequal access to recreational services and inefficient planning of new infrastructure.

The absence of an interactive Web GIS platform limits the effective use of spatial data for planning and public awareness. Therefore, there is a need for a Web-Based GIS that can visually represent recreational and sports facilities, provide easy access to attribute information, and support informed decision-making. This project addresses this problem by developing a Web GIS application for mapping recreational and sports facilities in Unguja, Zanzibar.

3. OBJECTIVES

3.1 General Objective

The general objective of this project is to develop a Web-Based Geographic Information System for mapping and visualizing recreational and sports facilities in Unguja, Zanzibar.

3.2 Specific Objectives

1. To collect spatial data related to recreational and sports facilities in Unguja Island.
2. To process and organize spatial data using QGIS software.
3. To convert spatial datasets into GeoJSON format for web use.
4. To develop an interactive web map using Leaflet.js.
5. To enable users to view facility information through pop-up windows and layer controls.
6. To demonstrate the application of Web GIS technology in urban planning and public service delivery.

4. STUDY AREA

The study area for this project is Unguja Island, which is the main island of Zanzibar, Tanzania. Unguja is located off the eastern coast of Africa in the Indian Ocean. The island lies approximately between latitudes 6°00′ and 6°30′ South and longitudes 39°00′ and 39°30′ East. Unguja is the administrative, economic, and cultural center of Zanzibar and hosts a large proportion of the population.

Unguja Island consists of both urban and rural areas, with major settlements including Zanzibar City and surrounding districts. The island has experienced rapid population growth and urban expansion, leading to increased demand for recreational and sports facilities. The diverse land use patterns and population distribution make Unguja an appropriate study area for evaluating the spatial distribution of recreational infrastructure.

Mapping recreational and sports facilities in Unguja provides valuable insights into their accessibility and distribution across the island. The study area boundary was obtained from OpenStreetMap and used as a polygon layer in the Web GIS application.

5. DATA AND METHODOLOGY

5.1 Data

The project utilized vector spatial data obtained primarily from OpenStreetMap. The datasets used include administrative boundaries, road networks, and point locations of recreational and sports facilities. The administrative boundary data represent the outline of Unguja Island, while the road

network data include major and minor roads. The sports facilities data include stadiums, playgrounds, and sports centers.

All datasets were processed using QGIS software and referenced to the World Geodetic System 1984 (WGS 84) coordinate reference system (EPSG:4326). Attribute data such as facility name, type, and ownership were included where available.

5.2 Methodology

The methodology followed several steps. First, spatial data were collected from OpenStreetMap using QGIS. Second, the data were cleaned and organized by removing unnecessary attributes and correcting geometry errors. Third, the datasets were converted into GeoJSON format to ensure compatibility with web mapping technologies. Fourth, Leaflet.js was used to develop an interactive Web GIS application. Finally, the system was tested to ensure correct display and functionality of map layers and pop-up information.

6. SYSTEM DESIGN

The system was designed as a client-side Web GIS application. The architecture consists of a web browser, Leaflet.js library, and GeoJSON data files. The web browser serves as the client interface, allowing users to interact with the map. Leaflet.js is responsible for rendering the map, managing layers, and handling user interactions. GeoJSON files store the spatial data and attributes.

The system design emphasizes simplicity, usability, and accessibility. Users can toggle layers on and off, zoom and pan the map, and click on features to view attribute information. This design ensures that the Web GIS can be used by both technical and non-technical users.

7. IMPLEMENTATION

The implementation involved creating HTML, CSS, and JavaScript files to develop the Web GIS application. The HTML file defines the structure of the web page, while CSS is used for styling and layout. JavaScript, together with Leaflet.js, is used to load the base map, add GeoJSON layers, and define map interactions.

OpenStreetMap was used as the base map due to its open-source nature and global coverage. GeoJSON layers representing administrative boundaries, road networks, and recreational facilities were added to the map. Pop-up windows were configured to display facility information when users click on point features. A layer control was included to allow users to toggle map layers.

8. RESULTS AND DISCUSSION

The final Web GIS application successfully displays recreational and sports facilities in Unguja Island. Users can interact with the map by zooming, panning, and clicking on facilities to view attribute information. The layer control allows users to turn layers on and off, enhancing map readability.

The results demonstrate that Web GIS is an effective tool for visualizing spatial data and improving access to information. The system supports the objectives of the project by providing a centralized platform for mapping recreational and sports facilities. However, the quality of the results depends on the accuracy and completeness of the input data, which may vary in OpenStreetMap.

9. CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

This project successfully developed a Web-Based Geographic Information System for mapping recreational and sports facilities in Unguja, Zanzibar. The system demonstrates the practical use of Web GIS technology in visualizing spatial data and supporting planning and decision-making. By integrating QGIS, GeoJSON, and Leaflet.js, the project provides an interactive and accessible platform for spatial information.

9.2 Recommendations

Future improvements could include integrating a spatial database, adding search and routing functionalities, and performing accessibility analysis. Regular data updates and field verification are also recommended to improve data accuracy and reliability.

10. CONTRIBUTION OF EACH GROUP MEMBER

⇒ **Member 1:** Collection of spatial data from OpenStreetMap
⇒ **Member 2:** Data cleaning and preparation using QGIS
⇒ **Member 3:** Digitization and editing of recreational and sports facilities
⇒ **Member 4:** Conversion of spatial data into GeoJSON format
⇒ **Member 5:** Development of the Web GIS using Leaflet.js
⇒ **Member 6:** Design of map layout, styling, and layer control
⇒ **Member 7:** Testing and validation of the Web GIS application
⇒ **Member 8:** Preparation of maps and screenshots for the report
⇒ **Member 9:** Report writing and editing
⇒ **Member 10:** Presentation preparation and coordination of group activities

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