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Short Review Paper

Creating of a database for the APIS information system

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Abstract

This article provides information on the creation of the APIS information system and database to provide pastureland users with information on pasture productivity and changes in natural external factors. Information in the system is provided by processing satellite images in GIS programs and using spectral indices. The use of the NDVI formula in assessing the condition of pasture lands, the use of field studies in determining the yield of plants, and the combination of the results of these methods are recommended to determine the state of productivity of pastures. Data on the Salinity index (SI) and Land surface temperature (LST) were also included using spectral indices to assess the effects of natural external factors on the productivity of pasture lands. Creation of the information system and database was developed taking into account the properties of these spectral indices. In the design of the database for the APIS system, the relational model was used as the database model, and the MySQL database management system was used to create the database. Reading and writing data from the database was carried out using the PHP programming language.

Keywords: Pasture, database (DB), geographic information system (GIS), remote sensing (RS), and automated pasture information system (APIS).

Introduction

Pasture lands are a vital resource for livestock production and contribute significantly to global agricultural productivity. Monitoring the health and productivity of these lands is crucial to ensure their sustainability and effective management. To ensure their productivity and sustainability, it is important to monitor their condition regularly[1]. One way to achieve this is through the use of spectral indices such as the Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST), and Salinity Index (SI)[2].

NDVI is a measure of vegetation cover and health, calculated from the difference in reflectance between near-infrared and red light[3,4]. LST is a measure of the land surface's temperature, which indicates vegetation health, water availability, and soil moisture[5,6]. The Salinity Index (SI) is a measure of soil salinity, which is a critical factor in determining pasture productivity[7-9].

To form a database of productivity for pasture lands using these indices, remote sensing data can be obtained through satellite imagery or aerial photography. The data can then be processed to calculate the NDVI, LST, and SI values for each pixel in the image. Once the indices are calculated, statistical analysis can be performed to identify correlations between the indices and pasture productivity, such as biomass yield or forage quality. The results can then be compiled into a database that can be used to monitor changes in pasture productivity over time and to inform management decisions.

It is important to note that the accuracy of the database will depend on the quality of the remote sensing data and the accuracy of the ground truth measurements used to validate the results. Therefore, it is very important to carry out frequent quality control to ensure the reliability of the data.

By using remote sensing techniques, these spectral indices can be extracted from satellite imagery and combined with ground data to form a database of pasture land productivity. This database can be used to monitor changes in vegetation cover, soil moisture levels, and surface temperature, allowing for early detection of potential issues such as drought, overgrazing, or soil degradation[1]. This information can be combined with ground data to provide a comprehensive understanding of the factors influencing pasture productivity. An information system can be developed to provide users with access to this database, enabling them to monitor pasture productivity and make informed management decisions.

The information system can be designed to provide users with visual representations of pasture health and productivity, such as maps and graphs. It can also include features such as alerts and notifications to inform users of changes in pasture health and productivity that may require immediate attention. It should be noted that designing an effective database is one of the most important tasks in the modern data-driven world. A comprehensively designed database helps in effective data management and facilitates data-based decision-making.

Taking into account the above information, the creation of the Automated Pasture Information System (APIS) database and information system can serve to ensure the efficient use of pasture lands.

Methodology

The process of creating and designing a database for the APIS system consists of the following stages: i. Determination of data requirements. The first step in designing a database is to determine the information requirements of the information system. This stage includes the identification of objects and attributes important for the information system. ii. Implementation of data normalization. Normalization is the process of data structuring to reduce redundancy in a database and improve data integrity. There are several levels of normalization and each level has its own set of rules to follow[10]. iii. Choosing a data model. There are several types of data models, including hierarchical, network, relational, and object-oriented models. The most commonly used data model is the relational model, which is based on storing data in related tables[11]. iv. Ensuring data integrity. Data integrity is critical to database accuracy and reliability. Primary keys, foreign keys and constraints are used to do this. v. Improving the efficiency of the database. Improving database performance can be achieved by using indexes, optimizing queries, and minimizing resource usage[12].

Based on the information analyzed above, it is necessary to design an effective database, formulate information system requirements, adhere to the principles of normalization, select an data model, ensure data integrity, and include such processes as increasing the base performance. Following these principles, an information system can create a database that enables efficient data processing and data-based decision-making [13].

Based on this, it is appropriate to choose a relational model as a database model when designing a database for the APIS system. To create a database, we use the MySQL database management system. This database management system works based on a relational model. Today, MySQL is widely used in creating information systems based on client-server technology[14].

The APIS information system includes several modules, so it is necessary to take them into account when designing the database for this reason; the database created for the system is divided into modules, each of which stores data in several tables.

The modules available in the database and the information stored in them are as follows: i. NDVI module, which contains information about plant condition and productivity; ii. SI module, which contains information about soil salinity; iii. LST module, which contains information about land surface temperature.

Results and discussions

The general information model of the database containing these modules was developed as follows (Figure-1). In this case, all the tables are connected to the Months and Years tables, and in these tables, the textual representation of months and years is stored, and other tables are connected to these tables by their ID numbers. All other tables store the Year_id and Month_id columns, and the ID numbers in this column are linked to the Months and Years tables, respectively.

Each module contains several tables and they are connected with other tables. All relevant information for the NDVI module of the system is stored in five tables, which is the largest module. The indvi_indeces table of the module contains the NDVI index, the ndvi_quruqs table contains the amount of dry biomass, the ndvi_pichans table contains sparse vegetation, the ndvi_gektars table stores information about water, sparse and dense vegetation in hectares. The tables of this module and the info graphic model of the connections between them are presented in the following figure (Figure-2). Data for the SI module of the system is stored in three tables. The first of them is the si_indices table, which stores information about the salinity index. The second is si_classifications, which stores information about the classification of lands with different degrees of salinity. Our third table is the si_gektars table, where the values of the land with different degrees of salinity in hectares are stored. The tables of this module and the infographic model of the connections between them are presented in the following figure (Figure-3).

There are 3 tables relevant to the LST module of the system, the 1st of which (lst_indeces) contains information about the LST index, the 2nd (lst_classifications) contains information about classified lands with different temperatures, and the 3rd stores information about the values of classified lands per hectare. Tables of the module and the connections between them are presented in Figure-4. The database mainly consists of these parts, and all the information needed to perform the functional tasks of the system is stored in these tables. Reading and writing data from the database is done using the PHP programming language, and the database is placed on the server[15].

Conclusion

In conclusion, the process of designing and developing a database for information systems affects the effective operation of the system in the future. That is why it is necessary to follow the basic principles and to organize them carefully in the development of the database. In this article, the stages of the development of such a database for the APIS system were considered. Based on the tasks of the information system, it is possible to divide the database into modules and thereby increase its efficiency. As a result, using this information system, it will be possible to effectively plan the use of pasture lands.

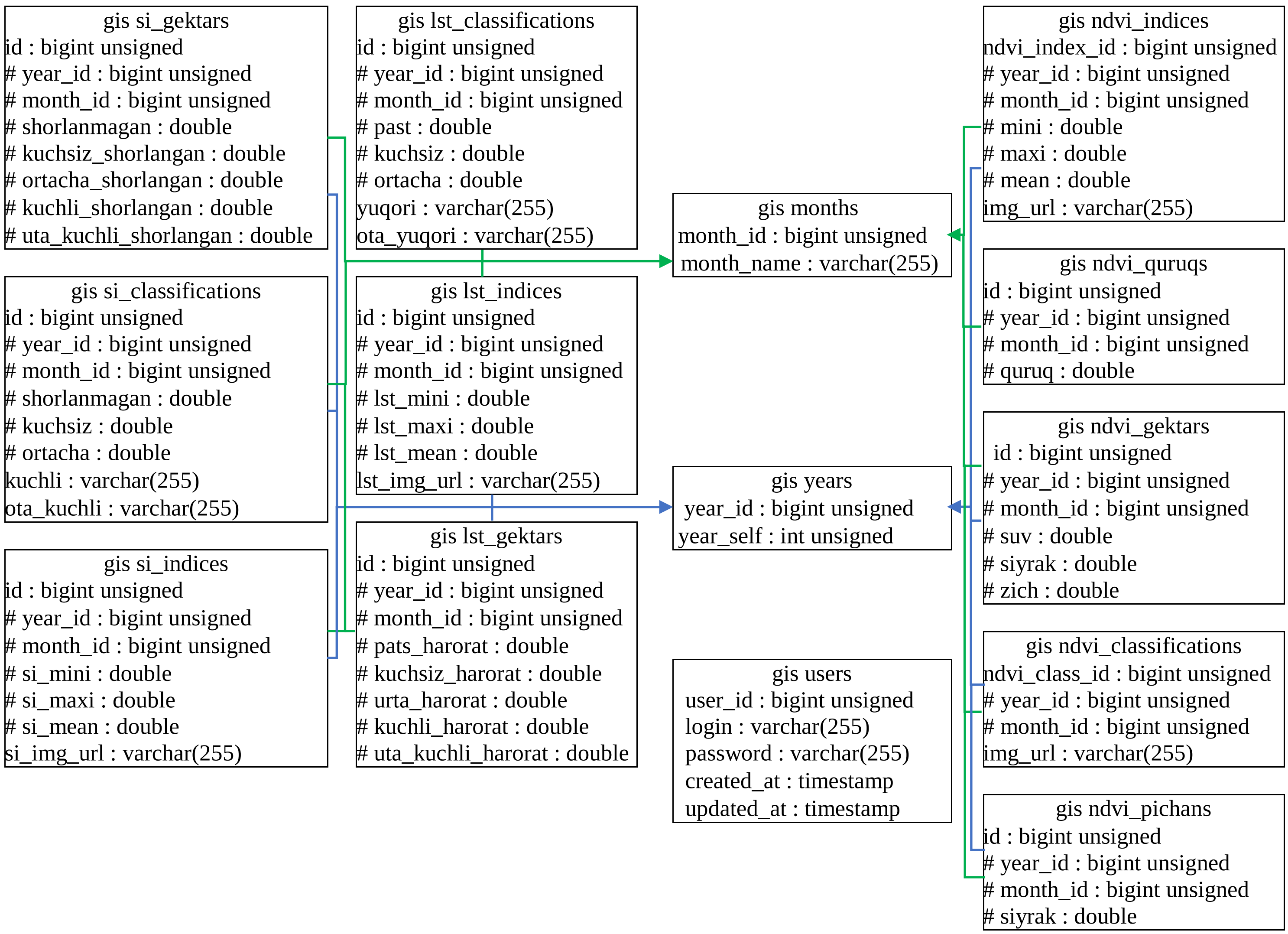

Figure-1: Infological model of the information system database.

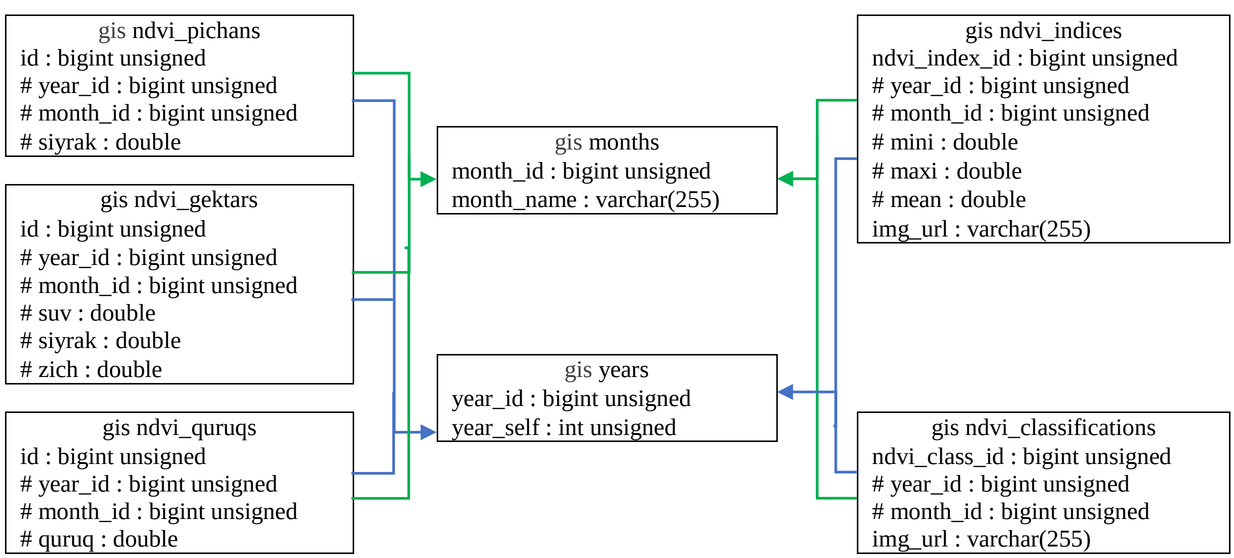

Figure-2: NDVI module tables infographic model.

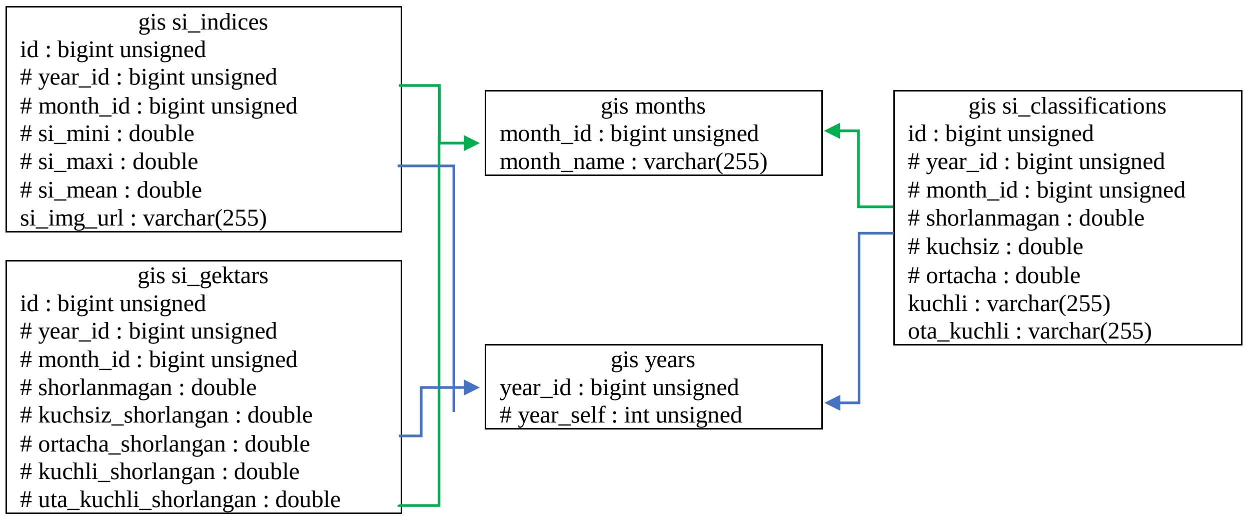

Figure-3: SI module tables infographic model.

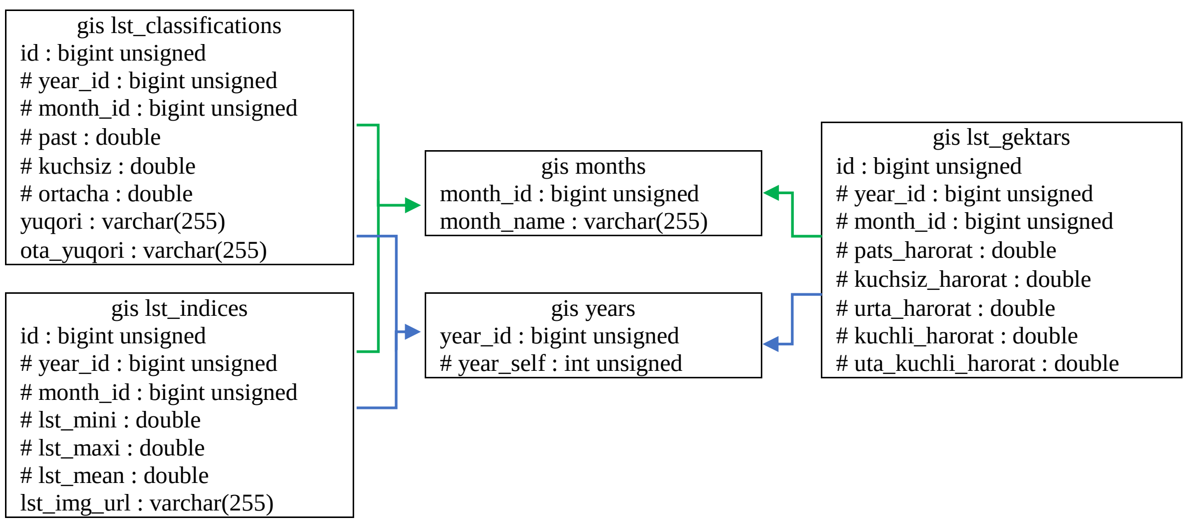

Figure-4: LST module tables infographic model.

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