International Journal of Enhanced Research in Management & Computer Applications, ISSN: 2319-7471
Vol. 3 Issue 8, August 2014, pp: (48-53), Impact Factor: 1.147, Available online at: www.erpublications.com

Geographical Information System for Farm Entrepreneur - A Review

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Abstract: The goal of this research is to investigate the potential of use of Internet GIS applications for agriculture farms. The study specifically examines the use of vector and attributes data and the potential of displaying and processing this data in new ways. It has increasingly been recognized that future developments in GIS will centre on Internet GIS, and in three major areas: GIS data access, spatial information dissemination and GIS modeling/processing. This research creates a methodological framework to achieve its goal that consists of three major parts: a database tier, an application tier and a farmer tier. This study demonstrates the uses of geographical information system (GIS) and multi-criterion decision-making framework (MCDM) in solving a agriculture multiobjective problem.

Introduction

Since India has a strong agriculture base and agriculture being the field of high developmental priority, the creation of a suitable Computational Agriculture Information System has become essential as development of agricultural sector is a potential catalyst for socio-economic development. The real test of technological development is whether it reaches people and the most important task is to produce, manage and deliver relevant information systems appropriately that are useful for the society. So, there is a need to locally develop information systems which are based on local needs and structures. That is why a country like India needs to adopt and develop information systems based on its own needs and structures, using their own methods and practices in the areas like healthcare, agriculture, education etc.

Some of the problems faced towards informatics development for agriculture in India are:

- Unavailability of appropriate Agriculture Information Systems to facilitate Agriculture Informatics suitable to the Indian requirements.
- Scarcity of experienced indigenous systems development resources capable of producing suitable information systems for the Agriculture sector.

This paper primarily focuses on developing Computational Agriculture Information System. Information Kiosks which provide the basic services like email communication, helps in education, health services, agriculture and irrigation, online trading, community services etc. We also need expert systems which help in determining marketing alternatives and optimal strategies for farmers, integrated crop management systems for different crops, Farm-level Intelligent Decision Support System [1] for risk reduction in agriculture and efficient irrigated agriculture.

Many Organizations and Institutes should utilize the information technology to provide solutions to the problems faced by the agriculture sector in a cost effective manner with proper business models. Still a lot of research has to happen in this area particularly in India. To control something, objects of which the mechanisms are known, are easy to control, but it is quite difficult to control an object such as agriculture of which the mechanism cannot be particularly explained. Hence most tasks have to rely on human capability rather than technology. However, if there is a technique to control agriculture, one can expect steady and high-quality harvests.

Literature Survey

K.Anji Reddy et. al. (2012) discussed that India has a strong agriculture base and agriculture being the field of high developmental priority, the creation of a suitable Computational Agriculture Information System has become essential as development of agricultural sector is a potential catalyst for socio-economic development. The real test of technological development is whether it reaches people and the most important task is to produce, manage and deliver relevant information systems appropriately that are useful for the society.

Ms. Neha Agarwal et. al. (2011) discucced that GIS is increasingly using geospatial data from the Web to produce geographic information. It is necessary to provide mechanisms to prepare data to help retrieval of semantically relevant data. Geospatial information (GI) constitutes to be the key factor in decision-making in a variety of domains, such as emergency management and agriculture. One way is the use of semantic annotations to store the produced and relevant information. This paper illustrates study of semantic annotations of agricultural resources, using domain ontology's.

Zhuang Weidong et. al. (2010) said that agriculture machinery guidance technology is one of precision agricultural important technologies. Based on GPS and GIS, it can raise working efficiency and improve the quality, reduce production costs, reduce driver working difficulty. This research's general goals realize the aided guidance function for agriculture machinery driving on road and straight line operation in the field by lightbar. The system uses Visual Basic 6.0 and MapObjects 2.2, uses the RS232 serial port communication, uses the AgGPS 332 receiver, uses the DGPS signal offered by Satellite Based Augmentation Systems, uses touch-screen vehicle carries computer for the superior computer, applies the existing area electronic map, develops region's farmland and path's geographic information system, enables the farm machinery to obtain the guidance information for transportation between the fields.

R. Jeberson Retna Raj et. al. (2010) described disaster management system based on GIS web services exclusively designed to handle the disaster such as tsunami, flood, earthquake, cyclone etc. The necessity of the system is many people lives in danger because of lack of providing timely help to the affected victims and tardy response of relief works. Disaster management system incorporates with GIS web services to identify the affected areas and possible routes to reach the location.

L. Jelínek et. al.(2010) deals with the ex-ante analysis of the effects of farm subsidies on farm behaviour. Beside that the risk factor is implemented in the farm model to reflect and quantify potential (negative) impact on farm results. A farm-level optimization model is used to assess the effects of different kind of policies and risk on production structure, income indicators and land use management.

Carlson (1987) proposed a model called the simplify complex. He used the term 0-simplex, 1- simplex, 2-simplex, and 3-simplex to denominate spatial objects of node, line, surface, and volume. His model can be extended to n-dimensions.

Molenaar (1992) presented a 3D topological model called 3D Formal Vector Data Structure. The model maintains nodes, arcs, edges and faces that are used to describe four types of features named points, lines, surfaces and bodies. The model belongs to the group of Boundary representations (B-reps).

Cambray (1993) proposed CAD models for 3D objects combined with DTM as a way to create 3D GIS that is a combination of Constructive Solid Geometry (CSG) and B-rep.
Other attempts to develop 3D GIS can be found in Kraus (1995),

Fritsch and Schmidt (1995), and Pilouk (1996). These attempts were based on the TIN data structure to represent 3D terrain objects but no reports exist on the any related aspects of using OO techniques for modelling and data structure.

De la Losa (1998) and Pfund (2001) proposed OO models similar to Molenaar's but have few more explicitly stored spatial relationships. For example, De la Losa maintains the relationship arc-faces as strict ordering of faces is introduced. Spatial data modeling and structuring of 3D spatial objects in G IS has not been as successfully achieved as in CAD

Work by Pilouk(1996) focused on the use of TIN data structure and relational database for 2D and 2.5D spatial data. He proposed an integrated data model for 3D GIS, which produced a practical approach to the problem.

GIS Functions

Any GIS system should be able to provide information about geo spatial phenomena. Principally, the following tasks represent some functions of a GIS system. The tasks or the functions of a GIS (Raper and Maguire, 1992) are: (1) capture, (2) structuring, (3) manipulation, (4) analysis, and (5) presentation, and can be summarized as follows.

• Capture is inputting spatial data to the system. Many different techniques and devices are available for both geometric and attribute data. The devices in frequent use for collecting spatial data can be classified as manual, semiautomatic or automatic and the output either vector or raster format. Detailed discussion on data capture is not covered here.

• Structuring is a crucial stage in creating a spatial database using a GIS. This is because it determines the range of functions, which can be used for manipulation and analysis. Different system may have different structuring capabilities (simple or complex topology, relational or object-oriented).

• Manipulation: Some-important manipulation operations are generalizationand transformation. Generalization is applied for reducing data complexity or to make the data presentation more legible. Transformation includes coordinate transformation to a specified map projection and scaling, etc.

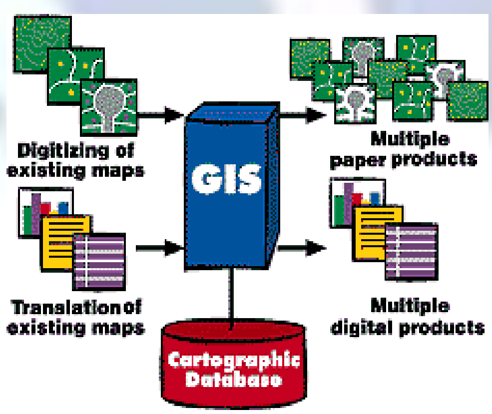
• Analysis, is the core of a GIS system. It involves metric, topological and/or order operations on geometric and attribute data. Primarily, analysis in GIS concerns operations on more than one set of data, which generates new spatial information of the data. Terrain
analysis (e.g. indivisibility), geometric computations (volume, area, etc), overlay, buffering, zoning, sorting are among typical analysis functions in G IS.

• Presentation, is a final task in GIS. That is to present all the generated information or results such as in the form of maps, graphs, tables, reports, etc. Ideally, a 3D GIS should have the same functions as 2D GIS. However, such 3D systems are not available due to several impediments such as problem associated with spatial data structures, spatial data models, and spatial data relationships, i.e. the topology, as discussed in Pilouk(1996),Zlatanova(2000), and Abdul-Rahman(2000).

Seven Main Task of GIS

1 Inputting the data
The data must be converted into a suitable digital format. The process of converting data from paper maps or aerial photographs into computer files is called digitizing.

2 Mapping
the mapping of maps is important task in GIS system .In traditional system the mapping is difficult to understand by computerized system but with the help of GIS Digital products for use in other GIS's can also be derived by simply copying data from the database. In a large organization, topographic databases can be used as reference frameworks by other departments.



3. Managing of Data
The managing of data like a data type for particular GIS project. This project will need to manipulate the data that can compatible with your system. GIS provide tools for manipulating the data and separate the unnecessary information

4. File Management
In previous days the data can store in files but when we want to store large amount of data then use DBMS (database management system) which can arrange ,manage, store and retrieving the data.

5. Query

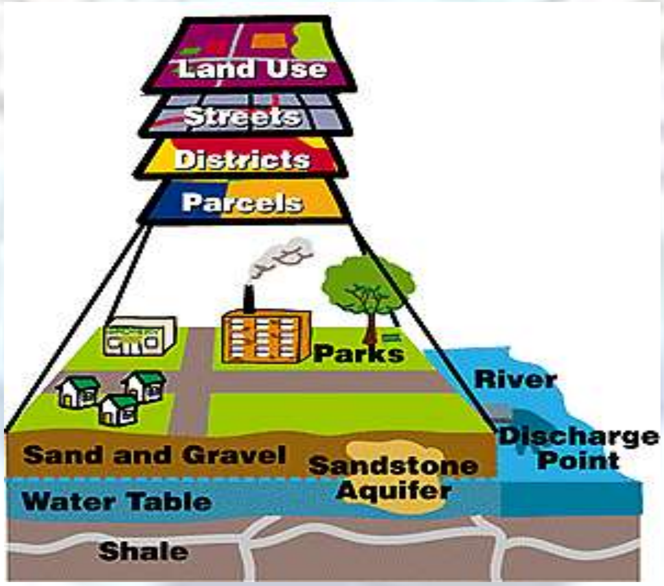
Once you have a functioning GIS containing your geographic information, you can begin to ask simple questions such as:

- How far is it between two places?
- How is this particular parcel of land being used?
- What is the dominant soil type for oak forest?
- Where are all the sites suitable for relocating an endangered species?
- Where are all of the sites possessing certain characteristics?
- If I build a new highway here, how will animals in the area be affected?

GIS provides both simple point-and-click query capabilities and sophisticated analysis tools to provide timely information to managers and analysts alike. GIS technology really comes into its own when used to analyze geographic data to look for patterns and trends, and to undertake "what if" scenarios. Modern GIS's have many powerful analytical tools

6. Analysis

Overlay Analysis integrates different data layers to look for patterns and relationships. At its simplest, this could be a visual operation, but analytical operations require one or more data layers to be joined physically. For example, to analyze the impact of urbanization on ecological characteristics of an area, an overlay could integrate data on soils, hydrology, slope, vegetation, and land use. Queries could be used to identify sources of pollution, to delineate potentially sensitive areas, or to plan for increased population growth in the area.



7. Visualization

The visualization is a result that can present the end of the project. In this we can visualize the map or graph which can store and communicate the information. it may be 3D, photographic, images and multimedia representation.

Application of GIS

GIS occurs in almost every industry. It is used for education, land management, natural resource management, environmental and aeronautical applications (data on rocks, water, soil, atmosphere, biological activity, natural hazards, and disasters collected for wide range of spatial levels of resolution) [1].

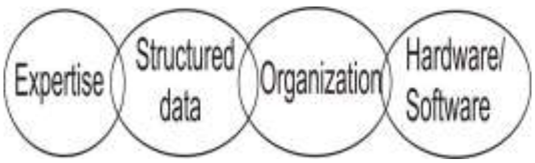


Fig. 1 GIS system suitability chain [5]

Although it is easy to purchase the parts of GIS (hardware and software), the system functions only when the requisite expertise is available, the data are compiled, the necessary routines are organized and the programs are properly modified to suit the application, and or organization's needs. GIS system suitability chain is shown in Fig. 1 [5].

Data Models in GIS

There are two fundamentally different types of geographic information.

The vector model

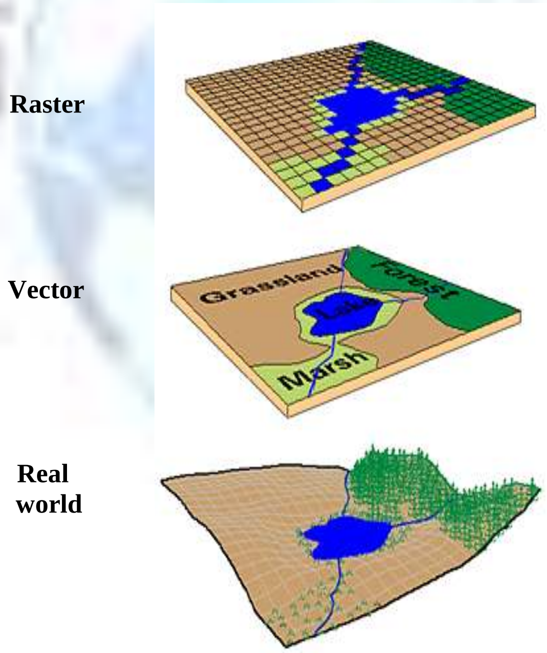
- information about points, lines, and polygons
- encoded and stored as a collection of x,y coordinates

The location of a point feature, such as a bore hole, can be described by a single x,y coordinate. Linear features, such as roads and rivers, can be stored as a collection of point coordinates. Polygonal features, such as sales territories and river catchments, can be stored as a closed loop of coordinates. The vector model is extremely useful for describing discrete features, but less useful for describing continuously varying features such as soil type or accessibility costs for hospitals.

The raster model

- models continuous features
- a collection of grid cells

Both the vector and raster models for storing geographic data have unique advantages and disadvantages and modern GISs are able to handle both types.



3D GIS

In this section, some problems and related issues in 3D GIS software development are reviewed and discussed. Firstly, what is 3D GIS? This type of system should be able to model, represent, manage, manipulate, analyze and support decisions based upon information associated with three-dimensional phenomena (Worboys, 1995). The definition of 3D GIS is very much the same as for 2D system. In GIS, 2D systems are common, widely used and able to handle most of the GIS tasks efficiently. The same kind of system may not be able to handle 3D data if more advanced 3D applications are demanded (Raper and Kelk, 1991; Rongxing Li, 1994) - such as representing the full length, width and nature of a borehole (some examples of 3D applications areas are listed in section 4). 3D GIS very much needs to generate information from such 3D data. Such a system is not just a simple extension by another dimension (i.e. the 3rd dimension) on to 2D GIS. To add this third dimension into existing 2D GIS needs a thorough investigation of many aspects of GIS including a different concept of modelling, representations and aspects of data structuring. Existing GIS packages are widely used and understood for handling, storing, manipulating and analysing 2D spatial data. Their capability and performance for 2D and for 2.5D data (that is also DTM) is generally accepted by the GIS community. A GIS package, which can handle and manipulate 2D data and DTM, cannot be considered as a 3D GIS system because DTM data is not real 3D spatial data. The third dimension of the DTM data only provides (often after interpolation) a surface attribute to features whose coordinates consist only of planimetric data or x, y coordinates. GIS software handling real 3D spatial data is rarely found. Although the problem has been addressed by several researchers such as Raper and Kelk (1991), Cambray (1993), Rongxing Li (1994), and Fritsch (1996), some further aspects particularly spatial data modelling using object-oriented techniques need to be investigated. Further, works of Pilouk(1996), Abdul-Rahman(2000), and Zlatanova(2000) have investigated the problems and proposed some solutions to the problems. Pilouk's and Abdul- Rahman's works were focussed on suitable data structures for the system whereas Zlatanova's work looked on the use of Web and 3D city buildings. The demand (or the need) for this kind of system is discussed in the next section.

CONCLUSIONS

The system utilizes GIS technique, integrate agro technique, scientific research result, experts' experience and computer technique, establish a comprehensive precision farming expert system which is high intelligence. Advantage of the system showed as below:

1. Well expandability System designed more interfaces to do more other functions, when the data and function increased,you needn't modify the system structure.
2. Well transplanted property System handle the data completely adopts the national standard design, consist of data sheet, encode standard, record format, make sure the software and data can matching exchange and share.

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