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Information Retrieval system for minor tanks in Sri Lanka using Google Maps and MySQL

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ABSTRACT: There are about 25,000 minor tanks in Sri Lanka. A minor tank is defined as a reservoir which irrigates less than 80 ha. of land. These tanks are operated and maintained by different agencies. As such there is no easy way to get information about them. Even the available information is in paper format and one has to wade through lots of paper documents to extract information.

In this project an information retrieval system was developed for minor tanks using Google Maps and MySQL. Google maps is a user friendly mapping software and MySQL is an easy to use relational data management system.

Google map was used as the base map and an application program interface was developed to connect the map to the MySQL database. The basic application was developed in PHP, a software which is freely available. The browsing capability was achieved through Apache web server.

Matara district was selected as a pilot project. There are 32 minor tanks in this district. The line government agencies were contacted to obtain the basic data about the tanks. The missing sociological and physical data about the tanks were assessed by visiting the tanks and interviewing government officials at the grass root level. The latitude and longitude of the centre of the dam was taken using a Garmin eTrex Vista GPS. A database named 'tanks' was created using MySQL. A database table named 'minor tanks' was created to store the social, physical, meteorological, and economic data collected during the study. An application was developed to insert, delete, modify and retrieve data. With the completed product a user can login to Google Maps, and with a click of a mouse button retrieve all data about a tank including a photograph.

KEYWORDS: Maps, Data bases, information management

1. INTRODUCTION

In Sri Lanka, a minor irrigation tank is defined as a reservoir which irrigates less than 80 hectares. There are about 25000 minor irrigation tanks in Sri Lanka. Out of these about 10,000 are in working condition and others lie abandoned.

Minor irrigation tanks are maintained and operated by different agencies. Information about these tanks is not available in easily retrievable form. Most of the data are available with different agencies and are primarily in paper format. As such anyone who wants to retrieve data on these

tanks has to wade through lot of documents which consumes time and money. Further there is no systematic mechanism to update data on a regular basis.

1.1 Purpose of this research

Purpose of this research is to develop a convenient and efficient information retrieval system for minor tanks in Sri Lanka. Proposed methodology uses Google Maps and optionally, MySQL relational database management system.

2. Google Maps

Google Maps is a web mapping service application developed by Google, which is free for non-commercial use. It offers street maps and satellite images for almost all countries around the world. Google Maps satellite images are not in real time. Depending on the location they may be several months or even years old. Google Maps uses a close variant of the Mercator projection, so it cannot show areas around the poles. Since the scope of this research is limited to Sri Lanka, the maps produced are not affected by this limitation.

Google launched the Google Maps API in June 2005 to allow developers to integrate Google Maps into their websites which is a free service. By using the Google Maps API it is possible to embed Google Maps site into an external website, on to which site specific data can be overlaid. Although initially only a Java Script API, the Maps API has since expanded to include an API for Adobe Flash applications, a service for retrieving static map images, and web services for performing geocoding, generating driving directions, and obtaining elevation profiles. Over 350,000 web sites use the Google Maps API, making it the most heavily used web application development API. This research uses the Google

Maps API to embed maps into its application

3. MySQL

MySQL is a Relational Database Management system(RDBMS) that is free and falls under the GNU General Public License (GPL). This is a database system used in most web applications. Basically, a MySQL database allows you to create a relational database structure on a web-server to store data. One disadvantage of MySQL is that creation of tables will have to be done by running SQL statements. However, this difficulty can be alleviated by using another open-source tool available online called PHPMyAdmin. PHPMyAdmin gives the user an easy-to-use interface that allows the user to create tables and run queries by filling in a little bit of information and then having the tables created. Currently, many web pages use MySQL to handle their millions of daily hits.

4. Data

4.1 Data collection

Three types of data were collected for each tank.

- Sociological data
- Hydrological data
- Physical data

Sociological data included number of farm families, type of ownership, type of usage etc.

Hydrological data included, average annual rainfall, evaporation, average temperature, average wind velocity.

Physical data included, type of dam, usage, area irrigated, number of canals, date of construction, current condition

4.2 Data sources

Major data source was the individual governmental agencies who own and operate the tanks. Three primary agencies who own these tanks are

- Department of Agrarian Services
- Irrigation Department (Central)
- Irrigation Department (Provincial)

Hydrologic data were collected from the Department of Meteorology.

After collecting data from the above agencies, it was observed that a substantial amount of data were still missing. A questionnaire was prepared and each tank was visited to collect the missing data. During this visit Garmin etrex GPS was used to get the coordinates of the centre of the dam. Other data were collected from the grass root level government officers and the farmers. A digital photograph of the tank was also taken during the field visit.

4.3 Data storage

As indicated previously, MySQL relational data base management system was used to manage data. However, in order to accommodate the users who do not have MySQL an optional text file was also used to store data. Data contained in both system were identical. The difference was in how the data were managed.

4.4 Data base design

A database named 'tanks' was created in MySQL. Within this database a single table named minor tanks was created with the field names, type and width as shown in table 1.

Table 1: 'Minor tanks' table structure

Field Name	Data type	Width
Name	Text	30
GSDivision	Text	20
OwnedBy	Text	15
Village	Text	15
Latitude	Number	10.6
Longitude	Number	10.6
DamHeight	Number	5.2
DamLength	Number	6.2
DamType	Text	10
CatArea	Numeric	5.2
FSLArea	Numeric	5.1
FSL	Numeric	6.3
HFL	Numeric	6.3
NumCanals	Integer	2
FarmFam	Integer	3
AvgRF	Integer	4
Evap	Integer	3

Table 2: Descriptions of field names

Field Name	Description
Name	Name of the tank
GSDivision	Grama Sewaka Division
OwnedBy	Agency which maintains the tank
Village	Village where the tank is located
Latitude	Latitude of the centre of the dam
Longitude	Longitude of the centre of the dam
DamHeight	Height of the dam in meters
DamLength	Length of the dam in meters
DamType	Dam type. Rock, earth, concrete etc.
CatArea	Catchment area in square kilometers
FSLArea	Surface area at full supply level hectares
FSL	Full supply level above mean sea level
HFL	High flood level above mean sea level
NumCanals	Number of outlet canals
FarmFam	Number of farm families
AvgRF	Average annual rainfall, in mm
Evap	Average monthly evaporation in mm

Descriptions of the field names used in the data base table are presented in table 2.

The table was then populated from the data collected, using the PHPMyadmin utility. As indicated earlier, a photograph of each tank was taken. The camera angle, orientation and location of the camera was selected in order to capture any other information which were not covered in the other data collected. Original photographs were taken with a 10 megapixel camera. As such each photograph was about 3MB in size. As this size is too large a low resolution version of each photograph of about 3KB was created using Microsoft Paint program. The photographs were stored in a separate folder named 'Images' created at the operation system level. Only the file names of the photographs were stored in the MySQL table. The original high resolution photographs were stored in another folder named HRImages. These images are not part of the information retrieval system, but are available to users who require high resolution images.

5, API

A web based application was developed using php. This application consist of four modules whose functionalities are explained below.

5.1Add data.

When the user clicks on the 'add data' button a form will pop up where the User can enter the data. Name of the tank, village, latitude and longitude are the only mandatory data. Other data are optional. As such a user can create a record with only these information. Name of the tank, and village is the composite primary key. This means that there cannot be two tanks with the same name in the same village.

5.2 Delete data.

When the user clicks on the 'delete data' button a form will pop up where the user is required to

enter the Name of the tank and village. Pressing the 'Delete' button at the bottom of the form will remove the record permanently from the database.

5.3 Update data.

When the user clicks on the 'update data' button a form will pop up where the User is required to enter name of the tank, and the village, and press the 'go' button. This will pop up a form with the currently saved information about the tank. The user can then update any data presented on the form, except, name of the tank and village. Once the new data are entered the user is required to press the 'go' button at the bottom of the form to update the database.

5.4 Data retrieval.

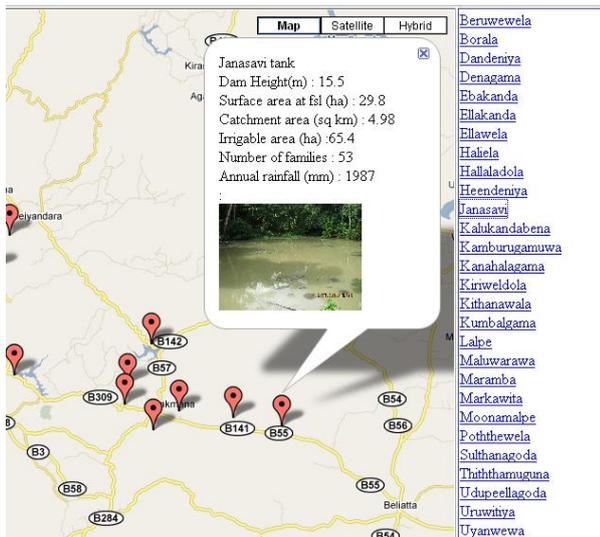
Most important function of the application is retrieval of data. For this purpose the user is presented with a map of the area with icons representing the tanks. In order to retrieve information about a tank, user is required to click on the icon relevant to the particular tank. This will popup a window with all available information about the tank, including a photograph. This functionality is illustrated in figure 1.

Figure 1: Retrieving data using icons



There are some situations where the physical location of the tank is not known, but only the name of the tank is known. A side panel with all tanks arranged in alphabetical order is designed to accommodate such a situation. Retrieval of information using this side panel is illustrated in figure 2.

Figure 2: Data retrieval using side panel



6. Advantages of using mySql

There are several advantages of using MySQL to store data. Some of them are

- MySQL is freely available for non commercial use
- Vendor supplied utilities can be used to manage data
- Fast data management
- Data can be easily exported to other servers
- Built in security model can be used to protect data
- Level of data access can be limited, depending on the type of user

Further to above more complex queries can be developed to retrieve data. For example, 'display all tanks where the number of farm families is more than 30, and irrigable area is less than 40 hectares,

and has an earth dam and are located in Lalpe village.

6.1 Limitations of using an RDBMS

The two major limitations of using an RDBMS are,

- The server need to have the RDBMS installed
- Scripts need to be written to create tables, and to populate them.

6.2 Data storage in an ascii text file.

When working with servers where an RDBMS is not installed, data can be stored in a text file. For this purpose a comma delimited text file containing the data needs to be created. The first two lines of such a text file is presented below for illustration purposes.

*Moragaha wewa,Meegama,Irrigation
Department,Meegama,6.070444,80.656944,
9.2,233.5,Earth,6.55,346.9,56.47,56.99,2,43,234,104
Lalpe wewa,Lalpe,Agrarian Services
Department,Lalpe,6.147654,80.543221,
7.3,134.,Earth,4.4,324.5,46.47,47.09,2,55,343,150*

6.3 Disadvantages of using a text file to store data

Three major disadvantages were identified in using a text file to store data.

- Data file can be protected only with a password. Multiple levels of access cannot be implemented
- Customized scripts need to be written to manage the data file. Or else the file will have to be edited manually. This is only suitable for small volumes of data.
- Retrieval of data is comparatively slow. As such this method is not suitable to handle large amounts of data.

7. Conclusion

An information retrieval system can be successfully developed for minor tanks in Sri Lanka, using Google Maps and MySQL, relational data base management system. Proposed methodology was illustrated using 32 minor tanks in Matara District, Sri Lanka. In situations where an access to a relational database management system is not available, data can be stored in a text file. However, performance of information retrieval substantially drops when using a text file. As such text files should be used only in situations where the volume of data is relatively small

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