Tank Update System: A novel asset mapping approach for verifying and updating lakes using Google Maps

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Abstract. Mission Kakatiya is one of prestigious programs of Telangana state government under which restoration of tank across ten districts is being implemented. As part of the program, government plans to restore about 9,000 lakes. Therefore, to have a comprehensive list of lakes existing in Telangana state, Samagra Tank Survey was carried out. Data collected in this survey contained about 45,000 tanks. Since the mode of collection of data was not in a standard format and was made using excel, a web interface was created to fill the gaps and to standardise the data. A new approach for spatially identifying the lakes through Google maps was successfully implemented by developing a web interface. This approach is less common since it implements the nature of asset mapping for the lakes of Telangana state and shows the advantages of using online mapping applications such as Google maps in identifying and cross checking already existing lakes on it.

1. Introduction

After the division of the state of Andhra Pradesh and formation of new state called Telangana on 2nd June 2014, the Government of Telangana has come up with a new programme “Mission Kakatiya” for restoration of tanks across the ten districts of Telangana. The name was given as a tribute to the Kakatiya dynasty rulers who had built a large number of irrigation tanks in Telangana state. “Mission Kakatiya” is one of prestigious flagship programmes of the government which went with the famous tagline - “Mana Vooru - Mana Cheruvu (Our Village - Our Lakes)“. Under the program, the government plans to restore about 45,000 tanks in the next five years. It will also be addressing the issues where tanks have been neglected and encroached.

Irrigation & CAD department of Telangana state is responsible for planning, designing, construction and maintenance of major, medium and minor dams [1]. The government of Telangana has instructed I & CAD department to take up Samagra Tank Survey during October 2014. As part of this exercise mandal level officers have gathered information on lakes existing in their jurisdiction and submitted them to the Chief Engineer of I & CAD. Initial estimates from the raw data indicate that there are about 45,000 tanks in the State. Since the data received from different mandal level officers was not in a standard format, there was an urgent need to compile the data and place it in a proper format. In this effort Telangana State Remote Sensing Applications Centre (TRAC) took initiative in compiling the data. After examining the data it was found that there were numerous missing fields where data was incomplete. Therefore, to standardize the data a Web based Tank Update System was designed and developed for inserting, updating and deleting the attributes of the surveyed data.
The approach taken up for the current study implements the nature of asset mapping which is defined as mapping of organized attributes of a community [3]. Asset mapping has been used by John McKnight and John Kretzmann for community development. It involves strengthening a community after analysing the mapped assets [2]. Most of the applications of asset mapping have been in the field of community development. The other major implementation has been in the field of crowd sourcing. Openstreetmap is one of renowned examples where users from all around the world can contribute free geographic data by digitising on the portals provided by it. iD and Potlatch are two famous editors which provide the tools needed for creating, manipulating and updating free geographic data. Both the editors use aerial imagery of Bing maps as background for tracing [5]. Delineation of water bodies forms one component of the various components existing on these interfaces. The current study implements this approach for identifying and capturing information of lakes using Google Maps. A few examples of identifying some archaeological sites were put forward by Fragen to bring forth the advantages of using Google Earth for reconnaissance survey. He suggests that even though Google Earth survey through remote sensing maps could never replace ground survey, it provides systematic aerial reconnaissance for planning and pinpointing sites before going into the field [6]. The current study uses this kind of approach in identifying the already existing lakes on Google maps which also acts as the background map for retrieving the coordinates of these lakes. ASP.NET, Google Maps and PostgreSQL database were used to build the application.

2. Data sets
Raw data collected as part of Samagra Tank Survey by the Junior Engineers (JE) was taken as datasets. Figure 1: Format for collecting data through Excel shows a format for data collection defined in an excel sheet. It contains twenty fields which need to be collected for each tank by all the JE’s.

Since, the format for collection of data was given as an excel sheet, the collected data had numerous errors and the standards were not followed while entering. To be able to implement the web interface for update by Junior Engineers (JE), the data was edited and was standardised at mandal level. A total of 45,000 records were submitted by the JE’s at the end of the survey. When all records were clubbed together, 3,000 records that were not in the standard format were discarded. The clubbed 42,000 records then were imported to the database for further processing. Two tables were created in the database - Tank Table and Login Table. Tank table was created with the defined fields of the survey.

Figure 1: Format for collecting data through Excel.
with some additional fields. These fields are used to link tank table to the login table. Figure 2: Shows the database table structure shows the structure of the table in the database where mandal code of the login table is used as an alternate key in the tank table. This key is used to query all the records from the tank table for that particular query of the mandal.

3. Design and application development
The web application for Tank Update System was developed using ASP.NET, JavaScript and Google Maps API. Junior engineers (JE) from I & CAD department are responsible for preparing plans and estimates for special repairs, additions and alterations of works/schemes. Since the preliminary work of collecting information for the survey was assigned to them, the application was built to have a login interface for each JE. Mandal name as login name was provided for each JE to login and to update
Figure 3: (a) Mandal names as user names for login; (b) Dropdown for selecting the type of tank; (c) Display of records in grid view after selecting type of tank.

information collected by them during Samagra Tank Survey. Figure 3: (a) Mandal names as user names for login; (b) Dropdown for selecting the type of tank; (c) Display of records in grid view after selecting type of tank. (a) shows a snapshot of the login interface provided for these JE's. For 472 mandals existing in the state of Telangana, 472 logins as mandal name were created and the password were distributed to them by the irrigation department.

Once the user logs into the applications, a drop down is provided for selecting the tanks based on categories. Figure 3: (a) Mandal names as user names for login; (b) Dropdown for selecting the type of tank; (c) Display of records in grid view after selecting type of tank. (b) shows a list of the existing categories under which the tanks fall. To demonstrate the capability of the application, let's suppose a Minor Irrigation tank from the list is selected. This would brings up a grid view which displays all tanks that come under this category for that particular mandal like shown in Figure 3: (a) Mandal names as user names for login; (b) Dropdown for selecting the type of tank; (c) Display of records in grid view after selecting type of tank. (c). Towards the left of Figure 3: (a) Mandal names as user names for login; (b) Dropdown for selecting the type of tank; (c) Display of records in grid view after selecting type of tank. (c), an "Edit Details" button is provided for editing data displayed in this grid view. A click on this edit button navigates the user to the edit interface of the tank.

The edit interface pre-populates the form text boxes with already existing data from the database for that particular record of edit button. The form contains some editable and non editable information. Fields with non editable information like Serial No., District, Constituency, Mandal and Village are greyed out and disable. This edit interface also provides the user with a novel way of collecting information from Google maps which is show towards the right side of the form in Figure 4: Edit interface of individual tanks with Google maps. Let's suppose a JE from Achampet has logged into the application. When the user navigates to the page shown in Figure 4: Edit interface of individual tanks with Google maps a marker at Achampet is displayed on Google maps. If any JE from any mandal logs into the application, a marker for the mandal he has logged into is displayed on Google maps. This way, the interface for identification of tanks existing in mandals or villages is made user friendly.
To spatially identify a tank two ways of collecting spatial information was provided. One way of collecting this information was by using markers in Google maps. The developed application has a provision to retrieve coordinates by moving the marker on the map. While moving this marker, the coordinates are updated dynamically and are displayed in the text boxes of the form for latitude and longitude columns. In Figure 4: Edit interface of individual tanks with Google maps a marker is placed at a tank that could be identified with sky blue colour towards the right. When this marker is moved, like explained it populates the latitude and longitude columns with coordinate information. The application has provision to switch between Map and Satellite view. In Figure 4: Edit interface of individual tanks with Google maps one can notice that only one tank with sky blue colour could be identified on the map view whereas on the satellite view dark colour patches for water bodies could also be identified. In addition to the tanks that have already been identified by Google Maps, the satellite view provides us with clear view of tanks which have not yet been identified. This way a preliminary survey could be carried out to obtain all the tanks that are visible on Google Maps and its satellite view to save time and effort in searching them on the ground. The other way of retrieving coordinates was by using GPS unit. As part of the survey, JE’s were provided with a GPS unit for obtaining the coordinates of tanks. By entering the GPS coordinates in the provided text boxes placed right above the Google maps satellite view window and by clicking on “Show Point” button, a marker is placed in the map for these coordinates. If the coordinates are in decimal degrees, they are automatically converted to degree-minutes-seconds and are then populated into the latitude and longitude section of the form. These two ways of spatially identifying the tanks was made as user friendly as possible for the JE’s. Hence, the developed application integrates both management of information and spatial tagging of this information.

Figure 4: Edit interface of individual tanks with Google maps.
4. Results and discussion

After building the application, it was deployed on IIS 7.5 server and the access was given to all the JE's. A progress page was created to monitor the activities of JE's for the records that were being updated and for new records that were being entered. While the irrigation personnel have not much expertise in handling web based technologies, the response shown by them in updating the data on the web was overwhelmingly positive.

Edit interface in Figure 4 has been the unique feature of the application. Its capability 1) to identify already existing tanks, 2) a satellite view to identify new tanks 3) the asset mapping approach of capturing geographic coordinates of these tanks through markers and 4) a provision to enter coordinates for the identified tanks through GPS has certainly reduces time and effort, and the amount of survey needed for establishing the database of the tanks. At the initial level of establishing the tank database, more than half of the tanks database could spatially be identified and created this way using Google Maps.

5. Conclusion

The purpose of the project was to provide a user friendly web interface to streamline the data obtained from tank survey and to spatially tag this data using Google maps. The kind of asset mapping approach implemented in this article is a novel way of retrieving already existing information on Google Maps which is shown to have been implemented successfully. Further it also helps in cross checking the collected information with established Google maps. The approach lowers the costs of survey by helping the junior engineers in identifying already existing lakes on Google maps and for identifying new tanks using its satellite view.

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