Designing a Spatial Database to Facilitate Road Maintenance Tasks

Introduction
Designing the Relational Database for Road Maintenance
Building the Spatial Database
Spatial Data Connection to Relational Database
Results and Conclusions
Recommendations
The reinstatement tasks deal with the fixation of all types of damage on the paved roads, which may be caused by:

- a settle down in the paving material (such as asphalt or interlock),
- leakage in the underground services,
- other factors like the rain.

The office work to finish the fixing of the task is approximately 3 working days.
Significance of the Study

✓ The Bahrain roads network (BRN) cover the majority of the lands in the kingdom, the length of the network is more than (3942 Km length).
  ▪ The study is only about one of the maintenance tasks for the surfaced roads, which is the reinstatement tasks,
✓ This study was designed to facilitate the following actions:
  ▪ Reduce time & efforts of the roads maintenance inspectors, by linking the reinstatement jobs with their locations.
  ▪ Reduce the paper work for the Road maintenance tasks.

Study Area (Kingdom of Bahrain)

The selected area of study is the Isa Town area, it was selected due to the availability of its spatial data at the information technology directorate at the MOW, this area contains 17 blocks and the available spatial data for this area was the shapefiles for Isa Town area and the surrounded areas, Blocks, Roads, Buildings and Addresses.
Objectives of the Study

- Design a spatial database to connect each job with a specific location on the field, which will reduce the time for storing and retrieving the reinstatement tasks.
- Build a pilot spatial database for the reinstatement jobs using the GIS techniques. (Small area – Isa Town).

Current Situation of RMS (Reinstatement Tasks)
Current Situation of RMS (Reinstatement Tasks)

Procedures of Reinstatement Task

- Receiving complaint
- Preparing site plan for site visit
- Taking measurements on the site
- Preparing the site plan marked by job locations
- Starting the office work
- Getting approval and issuing TCO
- Supervising the job
- Finalizing

Design the Relational Data model

Database Schema In The RDBMS MS Access (Physical Data Model)
First group of Adding Data Forms

Building the Graphical User Interfaces

Form Task Description

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Choosing the required procedure or service

This form gives the users the ability to choose the available services by pressing their button.

Add new Complain

Adding all required information to open a new complain.

This form is the most common form and can be used by all users inside the section, because there are requirements needed to use it.

Add new Project

Adding the information to open a new project for the complain.

This form must be used by the concerned technical staff for the area of complain. The requirement needed before using this form is to have an existing complain no for the new project, the complain must have an elementary approval.

Add new Address

Adding a new address for the project.

This form is to add the correct address for the area of work. This form will be enhanced in the next chapter to give the user the ability to choose from a map or even by check boxes before saving. It almost be used by technical staff.

Add new Location

Adding the information for each new location.

Adding new location must be done to an existing project, and address. This form must be used by the technical staff who will supervise the job. This form will be enhanced in the next chapter to give the user the ability to check the address.

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Second group of searching, Updating, and reporting Forms

Find Complain

Searching for the specific Complain.

The search method inside this form can be applied using several information in the complain address and the result will be shown on a table.

Update Complain

Updating the complain information.

The form is working via the find complain form, and it's similar to the add new complain form.

Find Project

Searching for specific Project.

The search can be done by even complain no or project no or by other information.

Update Project

Updating the information for specific Project.

This form gives the user the ability to add new location to the job.
Building the Query Forms of RMS Database

- How many patches completed every month in each area?
- What is the status of specific complaint or project?
- When a specific complaint has been completed?
- Prepare the monthly report?
- What is the total cost for the project in specific period of time?

Building the Graphical User Interfaces

Database Design

What to do with spatial database

- To link the non-spatial data with their locations in the reality by showing the answers of different queries on a map.
- The spatial queries that depend on the task location as on the following questions.
  - Where is the location of a specific complaint?
  - Where are the locations related to a specific TCO?
  - Where are the locations of specific address?
  - How many patches are there on a specific address?
  - What are the attributes of a specific location?
Choosing the GIS Environment

The criteria for selecting the GIS environment:

- Must be compatible with objectives of the project.
- Must be available and licensed.
- Must be able for updating and generalization process.
- Must be able to extend in the enterprise project rather than needed to reconstruct from scratch.

The selected GIS environment is: the ActiveX controls MapWinGIS from the www.MapWindow.org site.
Checking and enhancing the database

- Demonstration of Designed spatial-Relational database For Reinstatement tasks

RMS Database

Results & Conclusions

- The current situation of handling the Reinstatement task in RMS is time consuming, less productivity, and contains a lot of paper work.

- The deliverables of this research is a standalone application to facilitate the road reinstatement tasks for the road maintenance section, so it can save time effort, and cost of these tasks.
## Comparison of Current Situation with Designed Spatial Database

<table>
<thead>
<tr>
<th>Step</th>
<th>Time in the current situation</th>
<th>Time using the RDBMS</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving the complain file by complaining offices and open separate file for each.</td>
<td>1 hour</td>
<td>1 hour – this job is not inside the RDBMS yet</td>
<td>The time will be 5 minutes if the system generalized using the MOW intranet.</td>
</tr>
<tr>
<td>Open a project file for the complain and prepare for site plan – searching for the address and prepare maps.</td>
<td>1 – 4 hours depending on the original complain file and information</td>
<td>5-10 minutes</td>
<td></td>
</tr>
<tr>
<td>Visiting the site, determine the location, taking measurements, and register it on the printed map and the job requirements.</td>
<td>4 hours</td>
<td>3 hours just for the site visiting time</td>
<td>If the location Based services has been used the time will be 15 minutes.</td>
</tr>
<tr>
<td>Calculate the project cost and reporting for the senior engineer to take the approval</td>
<td>3 hours</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td>Add job to a TCO or creating new one. And issuing it.</td>
<td>1 hour using the existing contract system</td>
<td>1 hour using the existing contract system</td>
<td>If connected the time will be about 15 minutes.</td>
</tr>
<tr>
<td>Execute the task and update the status of the job on the project file and inform the others about completing</td>
<td>2 hour</td>
<td>5 minutes</td>
<td></td>
</tr>
<tr>
<td>Reporting the job in the monthly and other periodically reports</td>
<td>3 - 5 hours</td>
<td>5 -10 minutes</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13-20 hours = 3 working days</td>
<td>5 hours and 40 minutes = one working day</td>
<td>In the fully automating solution; the time will become 1 hour.</td>
</tr>
</tbody>
</table>

## Results & Conclusions

- The enhancement of the work productivity is about 3 times than the current situation,

- If the comparison had been applied- By neglecting the common factors e.g. the site visit time and the handling of the correspondences, then the enhancing is more than ten times the current situation.
Recommendations

✓ Adopting the results of this project by the MOW, and generalizing the project by replacing the existing sample base-map with the completed one for the whole country.

✓ The adaptation of this project to be the connector for all other strategies and systems (ESM, EDMS, ISO, Cost Center, and monthly reports).

THANK YOU