

PARADIS: Focusing on GIS Field Tools for Humanitarian Demining

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1. Introduction

Several problems are inherent to the process of supporting Humanitarian Demining campaigns with useful data: there is a lot of information to manage, data can be corrupted by errors of encoding and often no map of the zone of interest is available. Information systems have been developed in order to solve those problems and are now used in countries affected by Explosive Remnants of War (ERW). This paper explains how PARADIS addresses these problems, then focuses on the tools being developed for the field work.

2. Problems and their solutions

Within the framework of a Humanitarian Demining campaign, contaminated areas are often very large and represent a lot of information. This huge amount of data has to be compiled and safely stored in a central repository to avoid loss or corruption of data. Also, these data need to be represented in an explicit manner, in order for the user to work with them as effectively as possible.

Even when a system has been developed to solve this first problem, errors of encoding may appear when the user enters new data into that system; in order to ensure the integrity of the data, these errors must be eliminated.

Maps are key elements to campaign management and field work; however, as demining campaigns generally take place in developing countries, there is often a lack of accurate and recent maps for the zone of work.

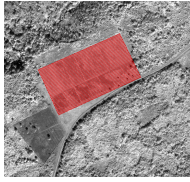
IMSMA (Information Management System for Mine Action) is the UN-standard information system for Mine Action and addresses the first problem. It consists mainly of a database located at the Mine Action Centre (MAC) of a specific country or region, into which all Mine Action related data is centralized. It also contains management and planification tools that process the information in the database in order to help decision makers.

EOD IS (Explosive Ordnance Disposal Information System) focuses on the second problem – data integrity. This system provides a GIS (Geographic Information System) based interface to the field worker to ensure that the data collected on the field is safely conveyed to the IMSMA database.

In order to provide the user with useful maps of the zone of interest, the PARADIS system uses satellite imagery (see [7]).

PARADIS also addresses the first problem by compiling and organizing the data related to the campaign in a geographic database (GeoDb). As PARADIS is built on a GIS, it presents the data to the user on a map rather than on a form. The map representation is more contextual than the form representation, and enables the user to really visualize the information, as it is shown on the following figure:

Perimeter of a minefield



GIS representation
(map)

X	Y
574,65	1,608,404
574,70	1,608,450
574,56	1,608,306

Database representation
(form)

IMSMA is database-centered, thus it mainly presents the data on forms. In order to fill the IMSMA database using a map, the user will be able to enter the data in the PARADIS system, then export them to IMSMA using the maXML (Mine Action eXtended Markup Language, see [7]) protocol.

Concerning the third problem, because it is GIS-based, the PARADIS interface intrinsically enables the user to verify that the data have been correctly entered. For example, when defining the perimeter of a minefield, if the user inverts the X and Y coordinates of a turning point, the latter appears at a totally different spot than expected. The wrong location of the turning point on the map warns the user about the encoding error he just made, and he then is able to correct the error.

3. Two interfaces

The needs of the campaign manager differ from those of the field operator. While the manager needs tools to help him make decisions at country and regional levels, the field operator needs an easy-to-use, lightweight tool to bring data to the field and collect new information while there. The PARADIS interface as it is described in [7] has been split into two separate interfaces in order to better fit the needs of both the campaign manager and the field operator.

The manager interface is located in the Mine Action Center (MAC); it is built on a full-featured GIS. As it needs to access the central GeoDb and may run big processes while manipulating the data, it is based on a desktop –or laptop- computer. It is hence referred to as the Desktop Interface.

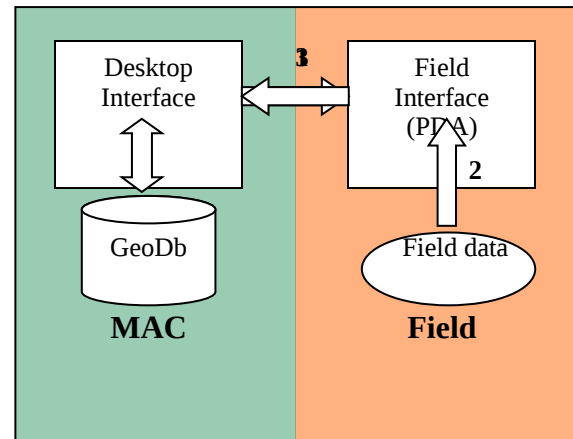
The field operator will work on a lightweight GIS interface called the Field Interface. The latter is running

on a Personal Digital Assistant (PDA), which small size and light weight make it the ideal tool for the field work.



A Personal Digital Assistant

The following figure shows the procedure that a field activity involves:



Desktop Interface (Point 1):

As the field operator needs geographic data such as maps, satellite imagery and its interpretation to support his activities, the first step is to export these data to the PDA. Note that the PDA user only needs data for the zone where he will be sent, so only a reduced set of geographic data needs to be exported. In the Desktop Interface, the manager reduces the set of data to the region of interest by drawing a bounding rectangle on the map. He then exports the enclosed data set to the PDA.

Field Interface (Point 2):

On the field, the PDA is used to collect new data such as: location of UXOs, bridges, audio/video files of

people interviews, etc. The user may also edit the existing set of data, which is very useful to enter information that cannot be known a priori. In particular, the only way to know the state of the roads is to go to the field.

Desktop Interface (Point 3):

When the field operator comes back to the office the manager gets the data from the PDA, verifies their integrity and puts them into the central GeoDb. As more and more data comes into the GeoDb, the whole region gets covered by the data brought in by the different field operators, which enables the manager to make decisions at regional level.

This process will be used during three separate phases of the demining campaign: Impact Survey, Technical Survey (Clearance) and Quality Assessment. In the following we describe the tools that are being developed for the Field Interface. Some tools are dedicated to one phase and will only be used during that specific phase, while other tools are of a more general use.

4. Impact Survey – Road Map tool

During this phase, surveyors are sent to the field to collect the information that will be used to evaluate the socio-economic impact of ERWs on the populations. In order to interview the populations about the ERW situation, they go from village to village along the roads of the region. In this context, the Road Map tool helps managing the itineraries the different teams of investigators will follow.

Desktop Interface:

This tool allows a road map to be created for each team of surveyors. In the Desktop Interface, the manager draws the itinerary to be followed by the team; the resulting road map is then exported to the PDA.

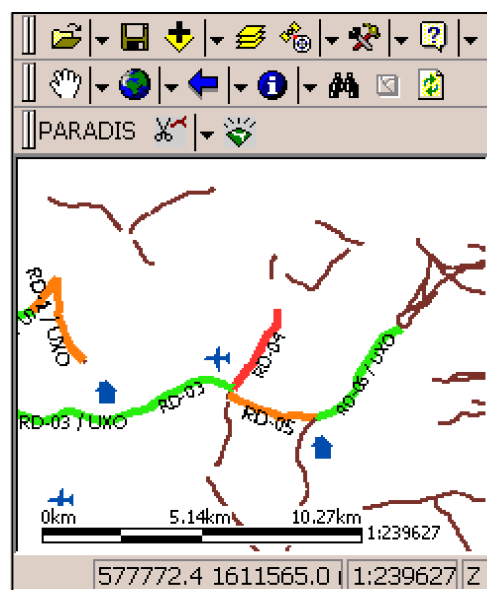
Field Interface:

Each segment of the road is namely given:

- a name;
- a status (not practicable, poor or good);
- seasons of practicability (if any);
- a type (tarred road, track);

- a mean speed depending on season of practicability;
- a mined status reflecting the estimated presence of ERWs along the road and the types of ERWs.

As one goes along the road, the status of the road may change (e.g. from poor to good). In order for the Field Interface to reflect this information, the road segment can be easily split up into several segments of different status. Conversely, two segments can get merged into one single segment.



The road color reflects the status of the road (brown= unknown; red= not practicable; orange= poor; green= good). The user can toggle labels to show the road name and its mined status.

When the team goes back to the MAC, these data are imported into the central GeoDb; after grouping the road maps of the different teams, a regional map of roads is obtained.

5. Technical Survey - Grid tool

This tool will allow the user to follow the work on a minefield. After delineating the minefield, the user will be able to draw a grid on the minefield. Each cell in the grid represents the small area that a deminer works on at a time.

Then, each cell will be edited to show the ammunition found in each cell and the status of the cell (not cleared, ongoing, cleared).

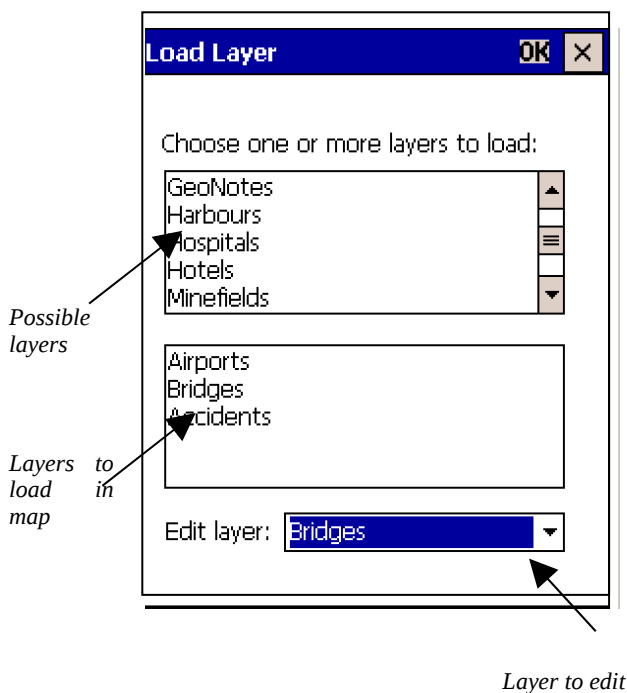
After a certain number of cells have been edited, the system will be able to compute the time for complete clearance of the minefield, given an estimated future numbers of detectors on the minefield.

6. General tools

The Layers tool makes the process of introducing new data into the system simple and powerful; the GeoNote tool enables the user to quickly associate different types of data to the same location on the map.

6.1. Layers tool

Using this tool the user may select dedicated layers from a list and insert them in the map (ex: airports, gas stations, hospitals, towns, UXO's, etc). The layers get then loaded with the appropriate pre-defined symbology.



The user may also choose to edit one layer directly, using the “Edit layer” box.

Note that the way of editing a layer changes from one layer to another. For example, the Bridges and Minefields layers differ in that a bridge is represented as

a point in the interface, while a minefield is represented as a polygon. Hence, to define the bridge point the user simply taps on the screen at the appropriate location. As the minefield is a polygon, the system behaves differently: when the user taps on the screen, the benchmark gets defined, then a form opens and lets the user define the other points. This is shown in the following figure:

Minefield OK X

Geo. Ref. Perimeter

Bearing : 90 °

Distance : 150 m

X : 574899.71

Y : 1607073.38

Add point Remove point

1 Bear= 125°; Dist= 45m; X= 574

2 Bear= 46°; Dist= 100m; X= 574

The form used to define the turning points of a minefield; these points can be defined by bearing and distance to the previous point, or by their X and Y coordinates.

The advantage of the Layers tool is that the system activates the appropriate editing method depending on the layer the user has chosen to edit.

6.2. GeoNote tool

Sometimes it is useful to associate heterogeneous information to a single point on the map, such as text, voice recordings, photos, or videos; in the interface, this point is called a GeoNote. As an example, if the PDA user interviews a mine victim, he would create a GeoNote by tapping the screen at the location of the interview. He would then associate to the GeoNote the audio file of the conversation, along with a sketch and a textual description of where the accident happened.

7. References

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2. N. Klemm and R. Bailey, Sharing Mine Action Information, http://www.hdic.jmu.edu/conference/casualty/maxml_files/frame.htm