

# Seamless Integration of GPS Data into a GIS using Visual Basic

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## **Abstract:**

A USAID-sponsored health facility survey is being implemented in several governorates in Yemen. Surveyors are sent to each health facility site to interview staff, take digital photos of the facility conditions, and collect GPS coordinates for integration of survey information into a Health GIS. After the initial survey, officials in each governorate will continue to update facility information for their region, including the collection of new GPS coordinates as more health facilities are built. To limit the need for highly trained specialists to add this new data to the survey database, an easy-to-use interface that automates much of the GPS and data entry requirements for inventorying facilities was developed using Visual Basic. This tool automatically pulls information from the GPS unit into the MS Access database, verifies that the coordinates fall within the expected spatial extent, and prompts the user to input basic facility details in a step-by-step process. The coordinates and facility attributes are stored in the database and the new facility location can be instantly mapped in the GIS along with the facilities from the original survey. Ultimately, this GPS data module can exist as a stand-alone tool, or be integrated into a MapObjects-based GIS system as an administrative-level data management module.

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## Introduction

The USAID-funded Partners for Health Reform*plus* Project (PHR*plus*) is working with the Yemen Ministry of Public Health and Population (MoPHP) to conduct a detailed Health Facility Survey in five USAID-targeted governorates (Al Jawf, Amran, Marib, Saada, and Shabwa). As part of USAID's Strategic Objective to increase the use of health services in Yemen, the survey is collecting vital, up-to-date information on the current conditions of hospitals, health centers, and health units. Developing a clear understanding of where facilities are and how they are being utilized is an important first step in strengthening service delivery.

The Health Facility Survey was conducted one governorate at a time, with surveyors visiting each site to collect GPS coordinates, interview staff, and take digital photographs of the interior and exterior conditions of the facility. Since funding to build and run health facilities comes from a variety of public and private sources, the MoPHP did not have a "master list" of all health facilities in the five targeted governorates prior to the survey. Therefore, the surveyors also used local knowledge to locate facilities unknown to the national-level ministry, which has given the MoPHP access to a more complete picture of the current state of health services in these governorates.

## Maintaining the Survey Database

PHR*plus* is using the GPS coordinates to integrate the survey information into a Health GIS. This survey data, combined with spatial and health data from other sources<sup>1</sup>, is an essential foundation for developing health analysis tools in the GIS. The survey results are also valuable as a standalone data set that can be shared among government agencies and donor organizations.

However, the value of this survey data will decline over time if the database is not continuously updated as new health facilities are built. For this reason, designated officials in each Governorate Health Office will be trained and made responsible for collecting new facility information in their region. This information will then be passed to a national-level counterpart for integration into the larger database. This approach supports the MoPHP's Health Sector Reform Strategy, which promotes decentralization of the health sector. It also ensures that "local knowledge" will play an important role in monitoring regional change and new facility construction.

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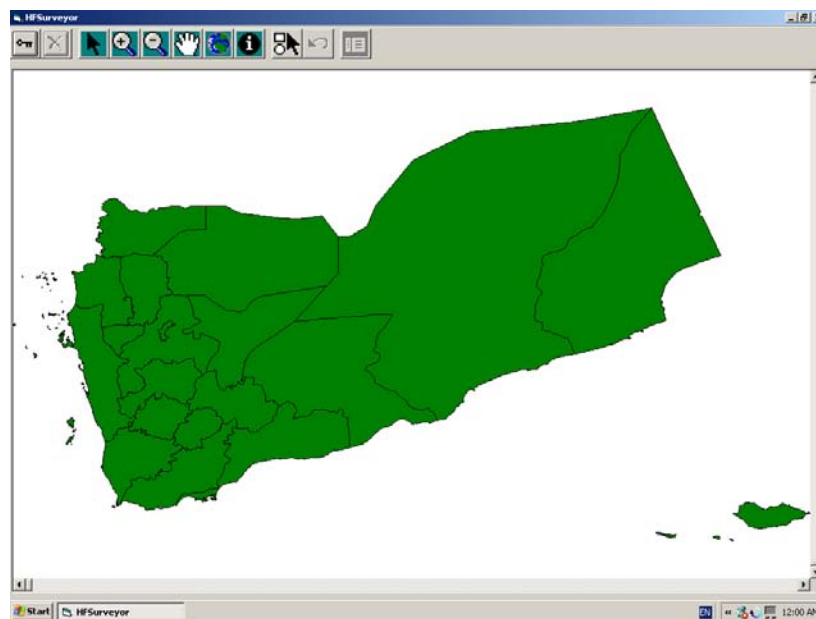
<sup>1</sup> Original base map data sets used by the PHR*plus* Project were taken from the Yemen Central Statistical Organization (CSO), the Social Fund for Development, and the Yemen Survey Authority.

Each governorate's designated health official will be given a GPS unit, digital camera, and survey forms, along with training on the data collection process. When a new facility is built, the official will visit the site, collect the GPS coordinates and survey information, and take photographs of the building. To facilitate the transfer of this new data to electronic format, a MapObjects-based tool has been developed using Visual Basic. It is designed to automate as much of the GPS and data entry process as possible, eliminating the need for a highly trained specialist to oversee the process. Additionally, this approach maintains consistency in the data by requiring officials in each governorate to enter their information through the same step-by-step process, ensuring that these updates will easily integrate into the existing survey database.

## **The GPS Data Integration Tool**

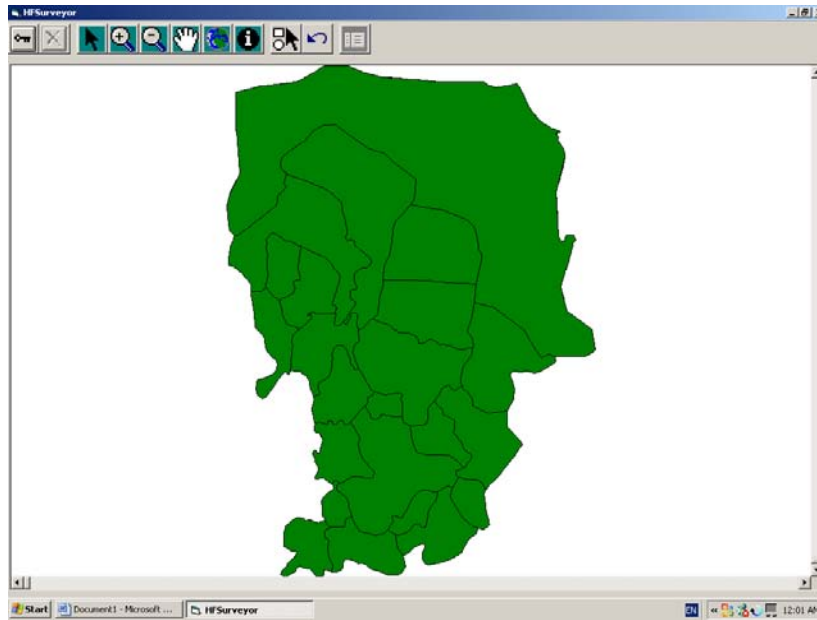
### *Identifying the Region of Interest*

The opening screen of the data integration tool shows a map of Yemen with the governorate boundaries (see Exhibit 1). The user must select the governorate where he is planning to add new data by clicking on the region on the map. This process limits the user's working area to the specified governorate.



**Exhibit 1. Selecting the Governorate of Interest**

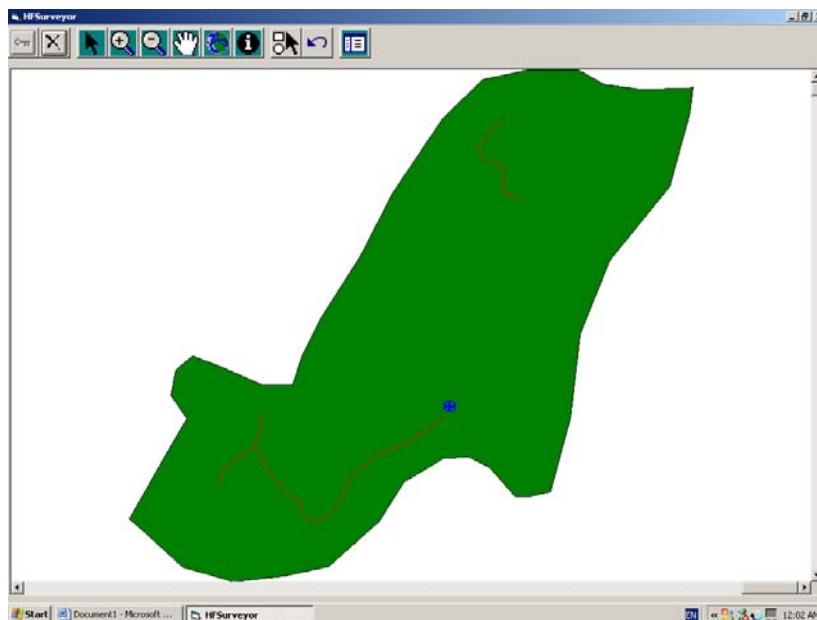
After selecting a governorate of interest, the map zooms in to that region and displays the governorate's district boundaries (see Exhibit 2). These boundaries will help the user recognize which district he is working in and identify any errors in his GPS reading (once the coordinates are loaded into the system) if the facility location plots in the wrong district.



**Exhibit 2. Zooming in to the Selected Governorate**

*Reading in the GPS Coordinates*

At this stage, the user makes a connection to the GPS by selecting the 'GPS Connection' button. When the GPS signal is received, a point is displayed on the tracking layer of the map (see Exhibit 3). The user can verify that the facility is plotting where it is expected to be on the map, and then disconnect from the GPS.



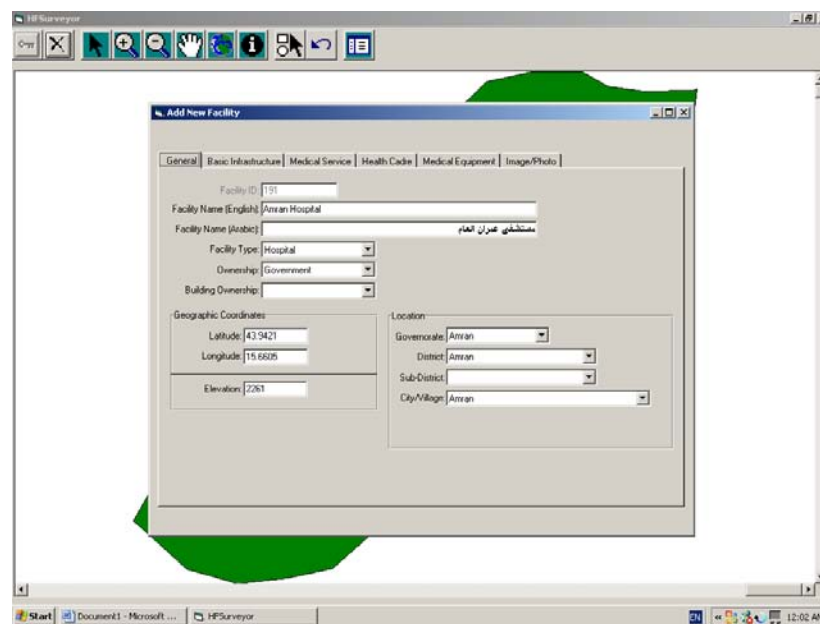
**Exhibit 3. Displaying the GPS Coordinates**

*Adding a Facility*

Once the GPS coordinates have been read into the system, the user can select the 'Add New Facility' tool to convert the point into a new facility record. This process saves some initial

facility information into the Health Facility database, including the latitude, longitude, and elevation (from the GPS unit) and the governorate and district names (from the map). At the same time, the facility's location is added to the Health Facility GIS point file. The user is not allowed to add the facility if the point falls outside the boundary of the selected governorate. This validation step is designed to ensure accuracy in the data entry process, and will inform the surveyor that there was a problem with the GPS coordinates recorded during the site visit.

After the location and initial facility information are automatically added, the user is presented with a data entry form to fill in the remaining survey information (see Exhibit 4). The form is based on the survey questionnaire, and allows the user to enter details about the health facility, such as: facility name, facility type, ownership, the year it opened, number of rooms, number of toilets, availability of electricity, availability of water, and type of sewerage system. At this stage, the set of photos taken during the site visit can also be loaded into the database.



The screenshot shows a software window titled 'HFSurveyor' with a toolbar at the top. A smaller window titled 'Add New Facility' is open in the center, displaying a data entry form. The form has several tabs: 'General', 'Basic Infrastructure', 'Medical Service', 'Health Care', 'Medical Equipment', and 'Image/Photo'. The 'General' tab is active. The form contains the following fields and controls:

- Facility ID: 191
- Facility Name (English): Amran Hospital
- Facility Name (Arabic): مستشفى عمران العام
- Facility Type: Hospital (dropdown menu)
- Ownership: Government (dropdown menu)
- Building Ownership: (dropdown menu)
- Geographic Coordinates:
  - Latitude: 43.9421
  - Longitude: 15.6205
  - Elevation: 2263
- Location:
  - Governorate: Amran (dropdown menu)
  - District: Amran (dropdown menu)
  - Sub-District: (dropdown menu)
  - City/Village: Amran (dropdown menu)

**Exhibit 4. The 'Add a Facility' Form**

## Conclusion

The GPS Data Integration Tool is one of many Health GIS and data management tools that PHRplus is developing. It can be integrated into PHRplus's customized Health GIS as an administrative-level module, or exist as a stand-alone tool. With either approach, the tool does not require the user to have an expensive GIS software license on his computer, or know how to perform high-level GIS functions and analyses. The ease-of-use of this tool means that the responsibility for survey data updates can be passed to the governorate-level, where officials are more likely to be aware of the health facility changes occurring within their districts. Therefore, updates should occur in a more timely manner and new skills can be introduced in the Governorate Health Offices. This ensures that the MoPHP Health Facility Survey will continue to be an up-to-date, valuable source of information in the years to come, and promotes health system decentralization and local-level capacity building with the health sector in Yemen.