ArcPad and Field Data Collection at the City of Garland

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Abstract

ArcPad applications for field data collection have proven helpful and profitable for the City of Garland, Texas. Garland's Geographic Information Systems Department worked with the City's internal consulting group, the Organizational Development Team (ODT) to develop a neighborhood survey using an ArcPad-based field data collection system. This opened the door for the same system to be used for other field GIS requirements, such as the City's Solid Waste and Recycling department, which has performed a profitable additional trash container inventory.

Background

The city of Garland has previously developed in-house applications for field data collection, such as the Pavement Management System used by the streets department for street inspection and work management since 1997, but did not have an off the shelf tool for developing field data collection applications. We began exploring ArcPad as a possible tool for rapidly developing and deploying field data collection and mapping applications in the summer of 2002. The first opportunity to deploy an ArcPad application was a request from the city's Organizational Development Team. ODT has been working with City management to explore methods to survey and track neighborhood quality.

Neighborhood Surveys

Tracking neighborhood vitality is an important issue for local governments. Declining neighborhoods will adversely affect a city's tax base, increase crime rates and drive away desirable homeowners creating a spiral of decline. This becomes not only a financial issue but also a quality of life issue for a city's residents. Some measurement of these trends must be used in order to intervene. But how can the quality and vitality of any particular neighborhood be measured? Garland's approach to measuring the vitality of its neighborhoods is a combination of data collection, analysis, and long-range planning tools. At the center of these efforts is the Neighborhood Benchmarking Program (NBP), which takes basic planning concepts and marries these with performance indicators, GIS technologies, and administrative strategies. The City's Geographic Information Systems Department supported these efforts by developing a Neighborhood Information System (NIS) in cooperation with ODT.

Building an information system such as the NIS presented some unique challenges. The NIS data warehouse contains data compiled from various sources, such as the City of Garland's tax system, Code Compliance system, Pavement Management System, Utility Billing System and information from other sources such as the local council of governments and realtor-oriented databases. Compiling these data required researching data sources, extraction from their native systems, conversion into Garland's GIS database format, geo-coding by address and other geo-based attributes, and in some cases creating new graphics and assigning new geo-codes.

To serve as an objective indicator of neighborhood conditions, the NIS compiles housing and nuisance code violations, street condition ratings, property values, litter index ratings, and other data from multiple city databases into one location for analysis. In addition, housing turnover rates, and economic indicators are derived from external sources. ODT also adds survey results and field-collected neighborhood appearance ratings to the NIS. Efficiently collecting samples of house and neighborhood conditions with limited time and manpower presented one of the greatest challenges of the project.

While much information necessary to the neighborhood benchmarking program is extant in city databases, some things can only be collected in the field. Observations based on objective sampling criteria for overall housing condition, so-called "curb appeal" and other items that are not contained in city databases such as sidewalk condition, lighting and signage.

System Requirements

ODT's requirements were that the field collection system be able to use existing parcel data displayed on a hand-held device, allow the user to select a parcel randomly chosen for the survey, add attributes to that parcel, and have the parcel graphic change color when the operation is complete to indicate that parcel had been surveyed. In addition, to assist the survey team with navigation and quality control in the field, a GPS unit would be used in conjunction with the hand-held devices.

To meet ODT's data collection needs, Garland's GIS department tested a system comprised of ESRI's ArcPad software running on a Compaq iPaq hand-held computer with a Garmin Etrek GPS unit. Using ArcPad's Application Builder, we constructed the dialog boxes and pick lists based on a data dictionary provided by ODT. The ability to quickly develop a menu-based data collection interface in ArcPad, and the ease with which ArcPad will work with GPS equipment made the ArcPad/iPaq/Garmin system a practical choice. The inexpensive Garmin was chosen, as opposed to a unit that docks to the iPaq, for its low price (under $100) and because it will perform better attached remotely from the iPaq, placed on the dashboard of the car where sky visibility is better. At any rate, high accuracy of the GPS was not a requirement, since its only purpose was as a general locator. Testing was successful based on the speed and ease of use of the system, so the full project proceeded.

Methods

At the beginning of each phase of the survey, ODT delivered the list of parcel addresses to be surveyed by neighborhood to Garland's GIS department. The GIS department prepared the shapefiles to be used in the surveys, loaded them onto the hand-held computers, and otherwise prepared the GIS/GPS system for each survey team.

After each day's work, the survey teams would return the hardware to the GIS department and the day's data was uploaded from the iPaqs. ODT had previously performed manual neighborhood assessments without the aid of field computing or GIS of any kind as a pilot, and the field crews found they were able to perform their surveys four times faster with GIS/GPS assistance. These data are currently being used by ODT in the analysis phase of the project to begin assessing and tracking the quality and vitality of Garland's neighborhoods.

Solid Waste and Recycling Services Residential Additional Container Inventory

Background

To increase revenue to cover the costs of disposing of solid waste produced by additional residential trash containers, Garland's Solid Waste and Recycling department planned to seek approval to charge customers for each additional residential trash container. Previously, customers were charged a one-time fee for the cost of the container only, not for disposal of the waste. The last known quantity of additional containers was just over 10,000, and since customers were not billed monthly for the extra containers, no reliable records were maintained to track these additional containers. So the city was devoting resources to the disposal of additional solid waste from as many as 10,000 households, and was not receiving additional fees for this service. As an example, a recent audit of the costs associated with disposal of the trash in additional containers found that it costs the city four dollars per additional container to dispose of the trash. If a four dollar fee for each additional container is recovered from the customer for the disposal of the additional waste, this could provide an additional $40,000 per month in revenue for Garland's solid waste and recycling service. But in order to bill accurately for the additional containers, it was necessary to perform a comprehensive inventory of existing containers and their locations. Based on our experience with the neighborhood survey project, we knew that the Arcpad/iPaq/Garmin system could assist with collecting the location of additional trash containers.

System Requirements

The workflow was simple enough, the user needed to be able to attach a number corresponding to the number of additional containers to each address. However keeping track of your location and which locations had been surveyed presented the biggest problems. For example, at a good working zoom level on the parcel map, you could accidentally be one block over and not be aware of it because the address sequences are the same in most subdivisions. A reasonably accurate GPS, like the Garmin, tied to ArcPad would solve this problem, keeping the map window centered at the user's location.

In addition, it could be possible in some cases to lose track of what parcels had been counted. This required that once an address had been surveyed, the map must indicate this by changing color, for example.

Methods

Building on the experience of the neighborhood surveys, we prepared a user interface and dialogs with ArcPad application builder that permitted the user to tap on a parcel on the displayed map, attach a container number attribute to each address, and after performing this operation the parcel would change to red indicating that it had been surveyed. The same GPS configuration was used with the Garmin connected via cabling and placed on the dashboard of the car.

The GIS Department Intern performed most of the survey and associated data management, but the Solid Waste Department also provided a vehicle, a driver, and another employee to assist part-time with the inventory. The workers drove each of the 64 residential routes on collection day (when the containers would be set out) following route maps that were downloaded to the hand-held computer at the beginning of each shift. Data from the day's collection activities was uploaded at the end of each shift.

After the location of additional containers was determined, this information was integrated into the GIS. This data will enable SWRS analysts to assess the numbers and locations of additional trash containers, and collect the proper fees for these multiple containers. It was estimated to take four months to collect all the necessary data and process the collected data into GIS, but the project completed a month ahead of schedule.

Results

The final results of the survey showed that there were over 13,000 additional containers in the city, more than estimated. These additional containers are now mapped and inventoried. The next step is for the Solid Waste Department to prepare a proposal for the Garland City Council outlining possible fee structures to charge residents for each additional container.

Potential Future Applications:

- Convert street inspections to ArcPad
- Develop manhole inspections in ArcPad
- Develop Water Quality Inspections in ArcPad

Conclusion

A common theme in the above two projects is the speed with which a field data collection project can be designed and implemented. Projects that seemed daunting prior to the introduction of the ArcPad/iPaq/Garmin system, were performed quickly and ahead of schedules. Although the GPS component of this system is not highly accurate (10 to 12 feet at best) for the purposes of these surveys it was a simple and inexpensive solution that more than met the needs of the project.

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