

Integration of GRASS within applications of geographic location on board of buses

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Within a more general project about management and control of public transport services, provided by SAD in Bolzano/Bozen, the necessity has arisen of managing the cartographies of Bolzano county and partly of Trento county.

The service rods and the description of connections among them have been necessary to manage on board buses services.

GRASS has been utilized for:

- raster maps acquisition of both provinces into UTM coordinates
- pointing out of rods, of ways of connection among them and service lines necessary to settle the service paths of buses.
- providing applications, lacking of knowledge of utilized GIS solution, with a X-window containing as background the cartographic maps of the required area with the drawing of rods and the connections inside. On this X-window the application superimposes its information.

The bus position is fundamental for services management

For service management is essential knowing the position of a single bus on duty either on board or at the central control unit.

A PC is installed on every bus with a LINUX operating system provided with (also) a GPS (global positioning system) for lasting recording of the current position. According to the current position, to geographic coordinates of these pointed out rods and to descriptions of routes, the bus is able to provide its position also as regards as the current rod or the last encountered rod.

The subsystem of position on board management of the bus allows

- to report changes of fares to the on board PC
- to keep under control the timetable service then making the actions required according to the value of the delay or the advance.
- to give its position to whom it may ask
- to warn the on board application and the control unit when passing or getting at a remarkable point.

Raster maps collection and cartography completion

Maps have been supplied in 8 bit TIFF format and they have been finished with the information required to provide some services:

Rods	service geographic points tied among them by the route the bus makes
Connections	route made by the bus to pass from a rod to another
Service line	Succession of rods with route concerning with connections describing the service route in a line clockwise and anticlockwise (obviously the route can't be symmetric).
Service line stop	The passage in front of a rod that gives rise to the information necessary to carry out the service: <ul style="list-style-type: none">• stop rod for passengers service or not• rod which changes the fare origin• rod of which is given the timetable• special rods in which one or more operations are requested (connection wait with other runs, signalling to the central unit or to the bus driver or to the onboard passengers and so on)

The survey of rods and connections has been made by a portable computer, with LINUX as operating system, on board of a mobile; the definition of the service route lanes and stops have been carried out after using the enterprise server.

Survey proceeding

Rods and service routes surveys have been designed with a suitable proceeding that makes use either commands or GRASS libraries by a graphic interface made in TCL/TK.

The geographic information management have been designed with GRASS while the portion regarding auxiliary information and the interaction with the user has been disegned with TCL/TK.

GRASS has been integrated into the proceeding at two different levels:

- 1 by commands execution regarding the maps raster management
- 2 by a dinamic library of extension to TCL/TK that makes use of GRASS libraries to manage vectorial information of connections, rods and graphic pick. The utilization of libraries is due to the high interaction with the operator. Besides the library implements algoritms and functionalities for all applications.

GRASS is used for:

- The automatic selection and visualization of raster maps of the examined county
- The geographic position acquisition, the selection (graphic pick) and the rod design according to the different drawing stile or enhancement.
- The acquisition, the graphic pick and the design of collections between the two rods always according to the different drawing stile or enhancement: detail of the broken line or just a single segment from the start rod to the arrival one or no design.
- Constructions and variations of service lines routes.
- the graphic display of acquired sites with the same procedure and then changed into GRASS format

Instead by TCL/TK was designed:

- user interaction management
- acquisition and management of auxiliary information of the single rod and connection
- service information acquisition of every line stop (from timetable or not, from changes of fares or not, from stop or not; and for connection rods also the list of any lines of which you can wait the connection).
- the current geographic county change and consequently the new drawing of elements contained in it (maps raster, rods, connections, sites).
- data needed on board buses.

Data reply

The need to approach to the data (just only reading) has arisen during the project, also in different places in which data are produced and, in addition, not steadily connected with the enterprise server.

Except for the starting step in which all raster maps have been acquired, the variation amount is quite small and this enables us to forward easily the variations made in the enterprise server to every *slave* machine.

The variations are allowed only on the server and are sent to every *slave* machine where a service for received updated data processing is working. The forwarded variations are ascii format and are independent from the hardware platform.

GRASS window resizing and automatic redrawing

One of GRASS most uncomfortable behaviour concerns the GRASS window resizing with the mouse to which GRASS answers cleaning the whole window.

The GRASS monitor knows the event but it can do nothing because it doesn't get the history of received drawing commands and it can't even ask them to the commands that forward them as they aren't working any more (almost certainly). On the other side the window contents can be the result of many commands execution and the redrawing could take the execution of whole or part of them.

A suitable solution is to signal the event to the application that makes the whole window to redraw with the necessary actions.

The solution we used was to get the GRASS window inside a top window of TCL/TK and tie the execution of redrawing function to the event *<Configure>* into the top window. The *embedding* of GRASS window into the top window was feasible with a tk extension: **TkSteal**.

But it was necessary to change the sources of XDIVER monitor to intercept the X event of window reparenting (ReparentNotify) and force its reappraisal after the ConfigureNotify event.

X window Server with geographic information used like generic applications background

GRASS has been utilized to supply applications unknowing cartographic solutions in use a X-window containing as background the cartographic maps of the required region, completed with the rods and contained connections drawing.

The whole project is made by:

- a server command accessing to the cartographic maps, rods, connections and manages the GRASS monitor communication and the current region changes operations, resizing, redrawing and so on.
- tkSteal extention utilization allowing to insert the GRASS monitor window inside a TK window.
- a new transparent canvas widget inTK with the canvas standard functionalities
- every moment it is possible to take away the transparent canvas getting again a full GRASS monitor where it is possible to start the connection graphic pick, the rod and so on

At the moment this X-window is utilized at the central control unit to get the position on the control pannel of buses you get trouble information from.

References

SAD - ([hppt://www.sad.it](http://www.sad.it)) operates in the Local Public Transport field in Northeastern of Italy. For information about the project see the report *Traveling Linux: An Implementation Experience for Unattended* di Maurizio Cachia - Linux Journal - giugno 1997 (<http://www2.linuxjournal.com/lj-issues/issue-38/index.html>)

For Tcl/Tk see <http://dev.scriptics.com>

TkSteal is an extension to Tk that allows the embedding of external programs like emacs and xterm (<http://www.neosoft.com/tcl/ftparchive/sorted/devel/>).

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