

DIGITAL IMAGE PROCESSING IN EDUCATION

András KNYIHÁR

Department of Photogrammetry
Technical University of Budapest
H-1521 Budapest, Hungary

Received: May 15, 1995

Abstract

GRASS (Geographical Resource Analysis Support System) is a well applicable system for raster, vector GIS and image processing on workstations. What is the problem of using GRASS in Eastern Europe in the education? The original software has some individual capability which are not available in Hungary. Which are these? The first part is the projection and the second part is the existing database, data source. We have different map projections and have got no detailed database of our country, but have the old traditional maps based on three kinds of projection. We can try to solve these problems with the extension of GRASS and establish databases as an example process of education.

Keywords: image processing, education.

Overview

The subject of current article is to present a part of education on civil engineering faculty; is the teaching of image processing and raster GIS. We established the Image Processing Laboratory in the Department of Photogrammetry, for the practical training. This lab has two main parts.

The first part is the oldest, PC based and the second ones are based on powerful workstations. On the *Fig. 1* we can see what are the elements of the system.

- The first PC has the Intel 486 CPU 8 MB RAM and 200 MB disk, high accuracy and large format digitizing board, colour inkjet printer 17" color monitor. This workplace plays an important role in map digitizing and desktop printing (i.e. result map production).
- The second PC has 386 CPU with MB memory and 100 MB hard disk and Super VGA card with multifrequency monitor. On this PC run the VGA ErdasTM software and our own developed raster education software named TERINFO. As we see this is the PC image processing workplace.

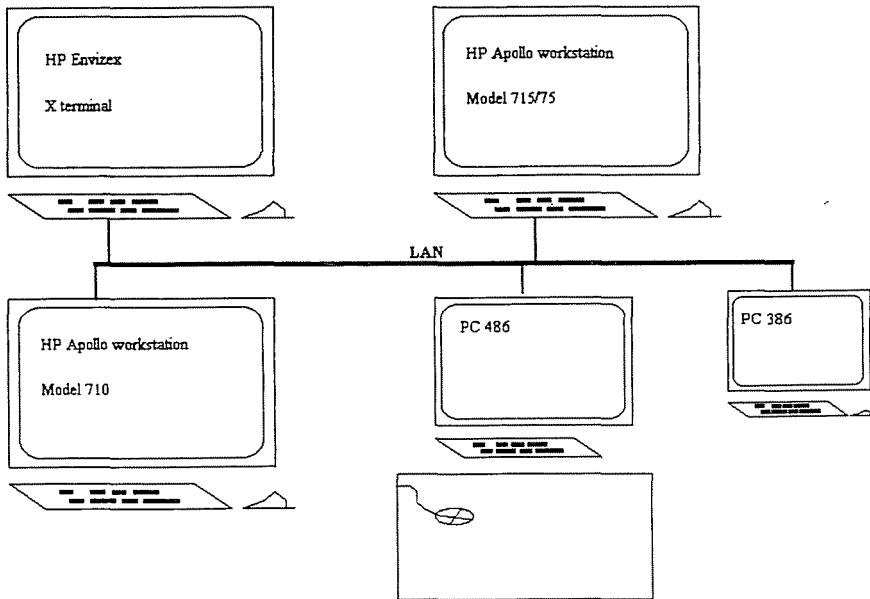


Fig. 1. The workplaces

The powerful hardware is basic of the workstation's image processing. We have two HP workstations. HP 710 with 16 MB base memory and 0.5 GB hard disk HP 715/75 with 32 MB memory and 1 GB hard disk HP EnvizexTM X-terminal.

All of three machine have 8 bit colour graphic and 19" monitor. We searched for UNIXTM based software and GRASS was the best. This software has part for image processing, raster and vector GIS. After the installation we detected the difficulties and problematic areas in using the software for our training. This system was developed in US and has capability for the special data availability. On the other hand, the map projections and map systems are different in our country. Furthermore we have the unique data acquisition system and exist database. For solving this problem we have developed some additional capability part of near GRASS separately.

Data Loading — Import Functions

The original GRASS software has import functions for external database access and converting to GRASS raster or vector data. The raster data is available from TM, MSS, . . . , Sun raster formats. Also, there is a program

for raster data loading in generic format, from tape. As we discussed about, we have different data sources, — own database (KNYIHÁR, WINKLER, 1993) — from we can get raster data in general form. For that we should create a simple general format reader program for file loading. The solution was rewriting the program generic tape reader to file reader. This program can read BIL and BSQ standard formats and that is suitable for our data converting to GRASS.

Map Systems and Projections

We have the different map systems in our country. The old systems founded on stereographic and cylinder projections. The map systems number is seven, because these have different datums. One of these map systems is very interesting. The system name is Gauss-Krüger. The projection of this system is transversal cylinder, what is rotated on six degree of longitude. This projection is very similar to the UTM world global system. The UTM is supported by GRASS. If we see the equations of these systems, the difference is scale factor only. The scale factor is, a unit under Gauss-Krüger.

$$\text{UTM} \begin{cases} x = (B + A_2\lambda^2 + A_4\lambda^4) \cos \lambda_0 \\ y = (A_1\lambda + A_3\lambda^3 + A_5\lambda^5) \cos \lambda_0 \end{cases}$$

$$\text{Gauss-Krüger} \begin{cases} x = (B + A_2\lambda^2 + A_4\lambda^4) \\ y = (A_1\lambda + A_3\lambda^3 + A_5\lambda^5) \end{cases}$$

	UTM	Gauss-Krüger
tangent meridian λ_0	1°37'15"	0°0'00"
false easting	500 000 [m]	(zone-30)×1000000 + 500000 [m]

(MISKOLCZI, 1980) (HAZAY, 1964)

After modification in source table and putting the new datum and projection parameters ellipsoid: Krassovsky, datum: Pulkovo, the new possibilitys were applicable.

About the User Interface (UI)

'The user interface (UI) is the part of a computer program which enables the communications and contact between the user and the program' (KNYIHÁR, 1992). We experienced the importance of user interface in our practice of

education. The national language and simple using of software are the primary standpoints. Why we considerate the simple using of system? We do not like spending long time for teaching the using of software. Similar, we do not like to deal with the software dependent structure of database, because in this field there is no standard in GIS, in the actual time. We would like to show and explain the common process of building and establishing of GIS database. Furthermore, we provide example processes as the technological range of mostly used GIS functions.

Supporting the national language by the UI is very important. This is need for menus and on-line help system and for national fonts (i.e. character sets for map creation) (Fig. 2).

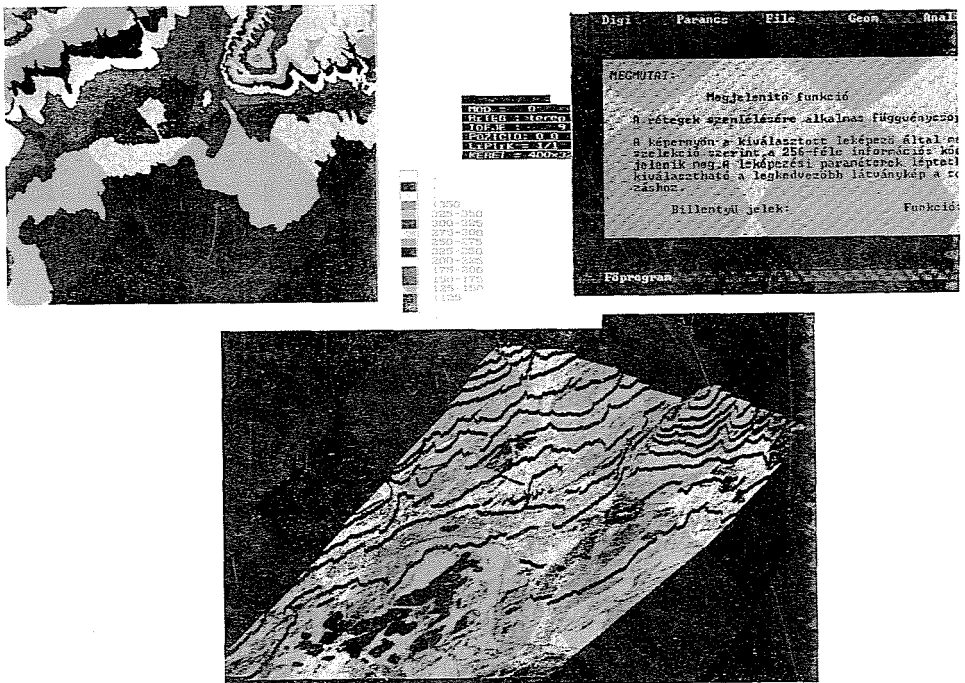


Fig. 2. The graphical user interface of TERINFO

There is an extension under X (X Window) to use language-sensitive routines to support NLS (Native Language Support) functionality. To build user interfaces based on this standard environment is highly recommended. There is the possibility for establishing national language interface builder, allow the user to create interfaces — menus and help pages, ... — in mother language.

In the beginning UI was command line oriented in GIS software. This realization is need for the knowledge of commands and syntax of their parameters or arguments setting. This is not very convenient for beginner user in system. The second step was the menu oriented approach. In this case using the software is simplest than earlier. If the aim of design was oriented for GIS processing then there are typical ways for processing, in menu system. Menus are good solutions for flexible using the software and for free roaming the different functions, but for this are the efficient data managements also needed. The newest method is the graphical user interface (GUI). What is this? 'A graphical method of controlling how a user interacts with a computer to perform various tasks' (ESRI, 1994). In developing GUI, we can combine menus and icons (graphical representation of character based menu points) and command-driven processing. If the background is the multitasking operating system is simultaneous using of the different function group possible — i.e. zooming and point editing —. To perform then capabilities in the course of development of the UI the first point of view must be the usual communication.

It means the software environment designed for ease-of-use and flexible manipulations.



Fig. 3. The new, platform independent GUI in UNIX™

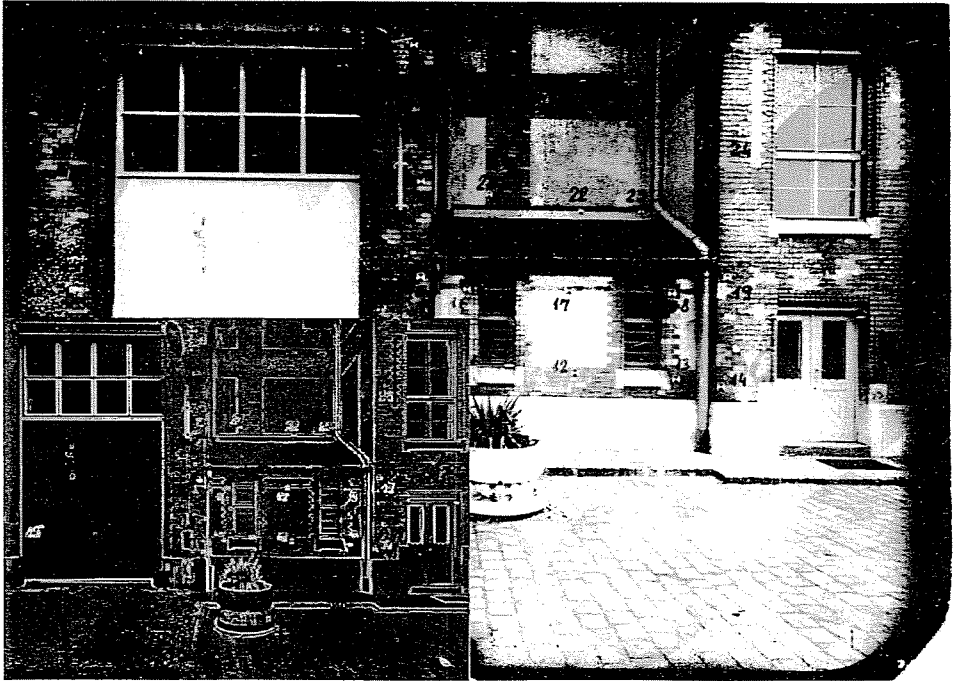


Fig. 4. Background is the original image and lower left is edge enhanced

This are the most flexible solutions of UI realisation and would increase efficiency and simplify using.

The main questions of the design are:

- What is the good separation of function groups — main processes, background — ?
- What is the efficient function mapping to the input devices — keyboard, mouse, digitizing table cursor menu or layer menu — ?
- How is the design visual — graphical representations of functions ?
- What are the default functions and their arguments?

We try to answer this question in our special environment and to solve for our educational application (*Fig. 3*). The main processes are: map digitizing, image importing — loading standard formats or scanning — image enhancement, classification, analysis and presentation. The background functions are: zooming, selecting areas, colouring. The implementation of functions are the following; the menus represent the main processing,

the icons activate background functions and for simultaneous running of routines there are some program functions keys.

On the last picture we can show an example of processing in the lab (*Fig. 4*).

Acknowledgements

We thank to the Hewlett Packard for supporting our education. Also thank to developers of GRASS and their offices.

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