Nedzved A., Belotserkovsky A. Elaboration of software complex of tumor monitoring by computer tomography images // proc. of 2nd International Conference on Advanced Information and Telemedicine Technologies for Health, Minsk, 2008, pp.86-90.

ELABORATION OF SOFTWARE COMPLEX OF TUMOR MONITORING BY COMPUTER TOMOGRAPHY IMAGES

A. Nedzved[1], A. Belotserkovsky[1]
[1] United Institute of Informatics Problems, Minsk, Belarus;

For elaboration of structural scheme of software basis interface an estimation of functionality and compatibility of existed software development tools were proposed. This software is based on the Interpretator LUA that allow to create modularity from different tasks.

Introduction

In recent decades we have seen a remarkable improvement in the diagnostic managements of oncology patients. We have also witnessed a technological explosion in the field of diagnostic imaging such a computed tomography (CT), magnetic resonance imaging (MRI), and angiography etc.

At present time CT plays a central role in the diagnosis and follows up of patients with malignant disorders and enables us to get imaging in transversal and sagittal sections, as well as reconstruction. CT gives accurate assessment of tumor size and spread more precisely than ever before possible and more than 40,000 CT equipment are currently being operated worldwide.

Over the past decade, the increasing technological sophistication of CT equipment has permitted excellent images with a limited dose of radiation which is currently equal to a plain chest X-ray (0,001 Gy) [1-3]. Modern CT uses special programs which save the information in DICOM size, usually these programs function for analyzing images and interactive measurements. They create the internal structure of the object, its archiving and interactively construct the size of the organ with the ability to identify the character of the pathological mass. Presently there are few special systems and complexes for the automatic diagnosis in medicine using imaging techniques, these systems, in general, belong to the diagnostic management of brain pathology [4-6]. Imaging studies play a key role in the diagnosis of Pediatric malignancies. CT imaging more than any other imaging modality provide documentation of the tumor extent, topography and characteristics. The use of additional intravenous infusion of contrast (CT-angiography) can give extra data about the blood vessels of the tumor and surrounding tissue.

Making an automated system of diagnostics and prognosis with CT-images is closely related to developing a technology, methods and algorithms of digital processing of 2D and 3D CT-images. At present general theory of image processing is not completed and in its growth [38]. There are no earnest computer programs for automated recognition and monitoring malignant neoplasm of mediastinum and retroperitoneal space. Moreover using of such a systems for child diseases should consider age-related differences of dimensional and other characteristics of anatomical structures. This fact deeply increases complexity of the task. Therefore, it is very up-to-date to create a system for 3D-visualization of a primary tumor lesion, characterization of it blood supply and for monitoring of therapy as well. Based on image processing and radiodiagnostical methods the system will bring high information density of data for primary diagnostics. It will allow to calculate a dynamics of regression in tumor masses, volume and vitality of residual tumor, which will increase a n accuracy of diagnostics and will compensate a lack of specialists in the field. Positive results will also help optimize a decision making in tactics and treatment. According to these facts one can assert that the project under consideration is most important for children diagnostics. In view of above, development of computer system for the automation of diagnostics and prognosis of mediastinal and retroperitoneal tumors in children based on analysis of radiological images has definite scientific novelty and significance in practice.

1. Structural scheme of software of 3D monitoring

Following neoplasms had been defined: Wilms' tumors and neuroblastomas. It will be studied next with the help of software tools. Signs of space-occupying lesions were defined since it has topological character (organ's shift and constraint). To describe tumors features with topological and densitometric characteristics were also found here. Most of organs have no constant topographical dependencies. The main task of the complex is carrying out monitoring of patient. To gain success next options are in need: measuring of characteristics, visualization, comparison of characteristics and images for several cases of investigation. Thus based on these requirements it was found that complex must have a modular structure which allows setting up and adjusting the system in terms of specific medical department. Analysis of existed solutions brings an optimal decision to use build up of interpreter for interlinking of software modules. There to different interpreters with open source BASIC, LUA, RYBA, JSCRIPS and XML were analyzed, which are distributed under GPL license. LUA one has been found as the most suitable case since it has a required structure of extended programming, support for interface design and libraries with SQL handle. Available libraries for 3D visualization and image processing were also considered. It had been chosen a VTK package (for 3D visualization) and ITK package (compatible image processing library). Finally, tools and methods for programming had been settled as well as initial data and tasks for complex. It will be used for creating and elaboration.

For elaboration of structural scheme of software basis interface an estimation of functionality and compatibility of existed software development tools were proposed. Tasks which may be solved with software to be developed, initial data, diagnostic features and characteristics have been observed.

During carrying out the task a structural scheme was elaborated. (fig. 1) According to it software provides links and connections in Clinical Data Complex (CDC) in two ways:

1) via read/write procedure in DICOM format;
2) via transferring image and data as structured array.

In the first case data are processed using temporary file, which allow to analyze records (images) without real-time connection with CDC. In another case a transfer by calling a run-time library from CDC-client is performed.

New interpreter of LUA language was elaborated as main module, which may provide an interaction of complex components. It includes graphical interface, global variables, image structure. Architecture of graphical interface has been carrying out by linking an FLTK library. Such a solution gives a possibility to design new interface elements both by text programming in LUA interpreter and by graphical instrument FLUID.

Image structure is determined by module of graphical interface SNAP, which is responsible for visualization of 2D and 3D images. Headers of image structures of SNAP are global variables of interpreter LUA. A SNAP module also includes image read/write function, simple functions of processing and interactive contouring. All interactive functions return values in the event block, which change global variables of interpreter. SNAP module provide interaction of user with Complex and allow to process and analyze one 3D image. For tasks of monitoring space-occupying lesion a simultaneous using of several SNAP modules are required. In the given case an interaction with it has been performing by global variables of LUA interpreter.

Adding new functions of processing and analysis is carrying out by group of developer's function. As an input new functions may get any global variable or text and numerical constants from LUA interpreter.

All internal controlling of Complex is carrying out by text scripts of LUA, which are divided into two categories:

1. scripts for graphic interface;
2. scripts for operative functionality and setting up of Complex at workplace of medics.

All scripts are stored in text and easy to access. However they are not for changing by user and may be edited for by developers only.

2. Creation of software package of program shell

The aim of the given task is a development interface of Complex. Libraries of new interpreter

LUA, visualizing VTK (SNAP module) and graphical interface of FLTK program (fig. 2) are underlie in the base of program shell "fluid" (fig.3) and visualizing functions.

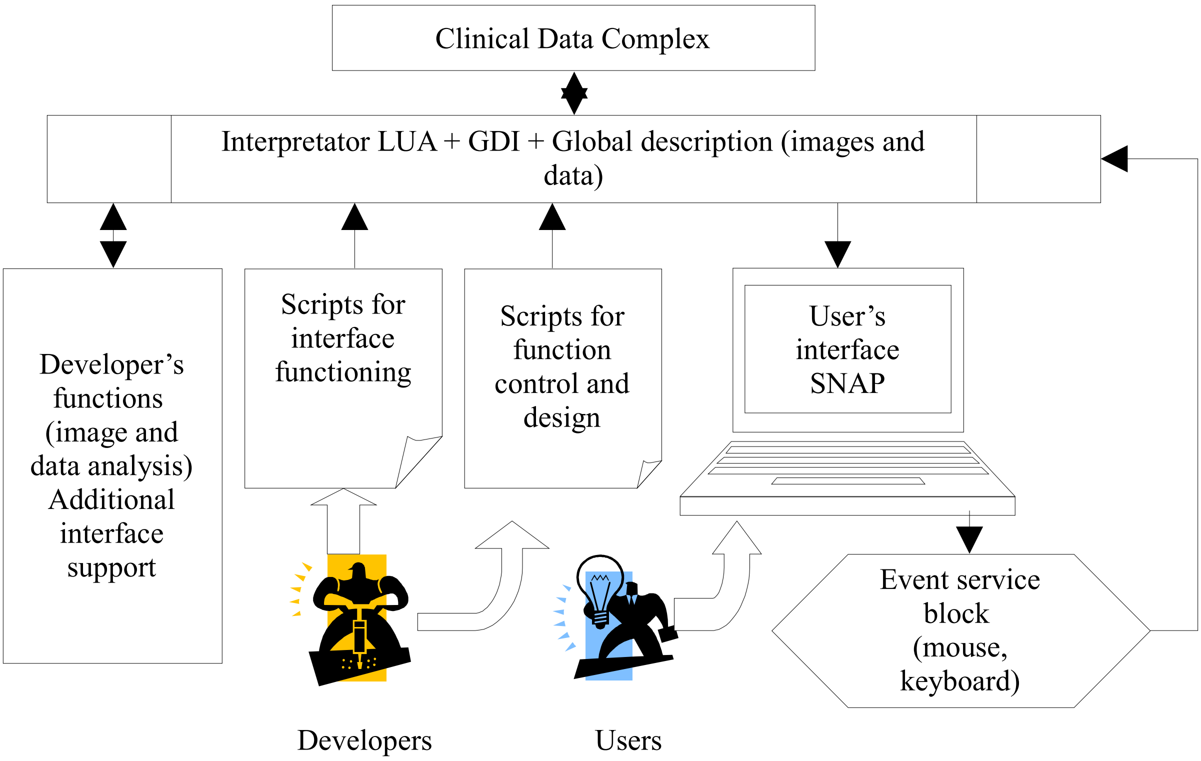

Fig. 1. Structural scheme of software basis interface

Ways of interactions of different software modules and it development are defined here. A basic toolkit of providing interaction and performance of software modules.

A elaboration of graphical interface is to be developed with the help of scripts of LUA interpreter. It may be designed both as simple text ASCII editing and with graphic shell for development of FLTK applications FLUID and file converter for scripts. Example of generated script for drawing button is the next:

```
window = fltk:Fl_Window(505, 145, "My first little app")
fltk:Fl_Button(5, 5, 310, 135, "My First Button")
fltk:Fl_Button(320, 65, 180, 35, "Load a picture")
fltk:Fl_Button(320, 105, 180, 35, "Quittin Time")
window:show()
Fl:run()
```

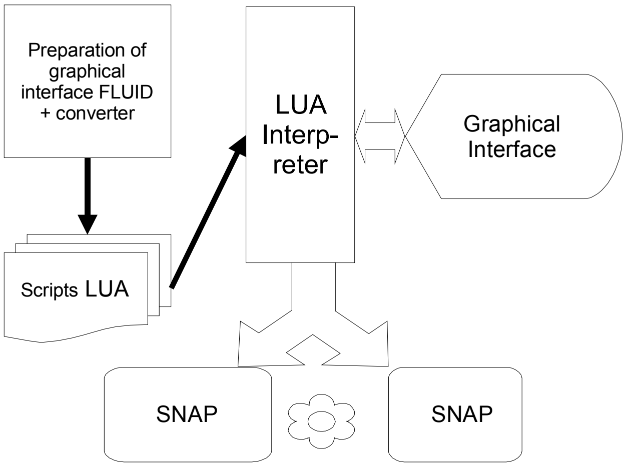

Fig. 2. Scheme of preparation of software graphical interface

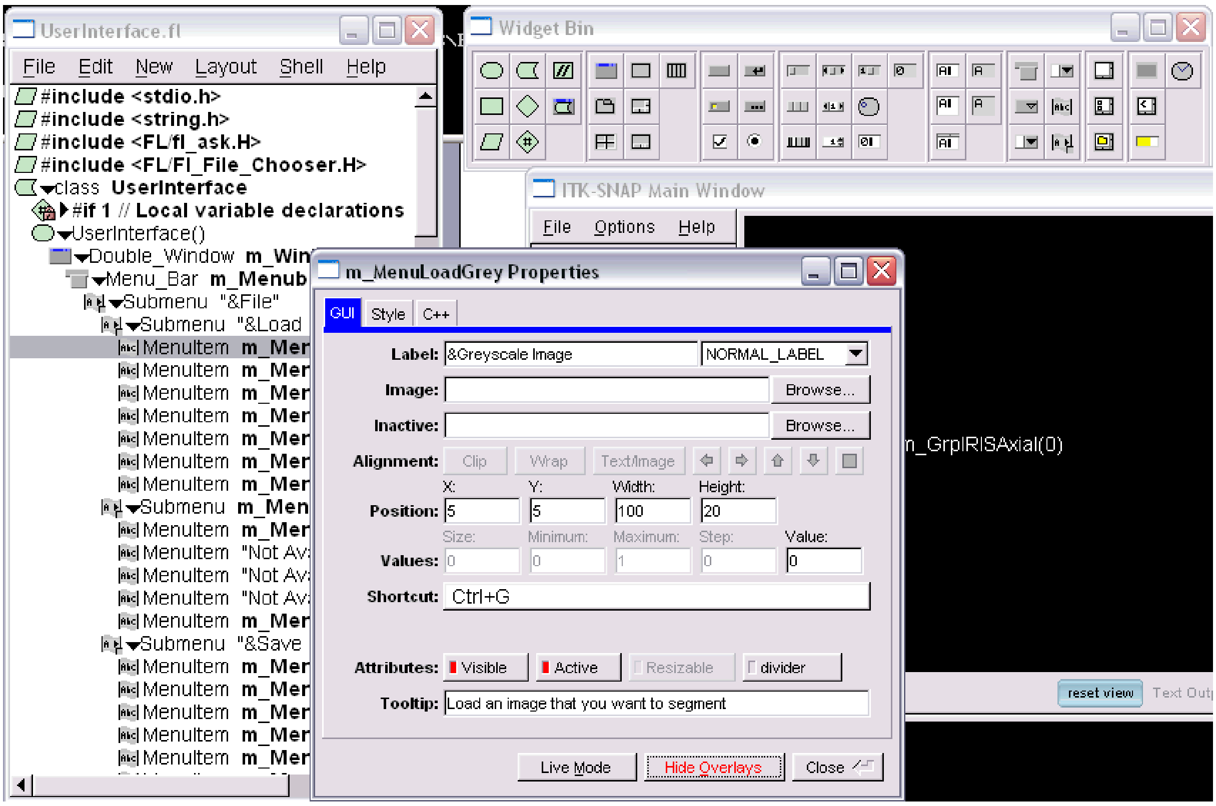

Fig. 3. Screenshot of developing graphical interface in Fluid

Calling of SNAP module window is performed by LUA interpreter command and allow to call several windows simultaneously. To make possible an interaction between SNAP module and LUA a SNAP was transformed into DLL library.

Conclusion

The method for software development scheme for monitoring CT-images is described here. It is a module-type method which allows to change an interface view rapidly according to specific task using scripts of LUA-interpreter. A Graphical user Interface LFUID makes it possible to change an complex exterior without professional skill in programming. Overall module-based organization is the best solution for complex architecture since it allows to support universality for its fragments (modules) and use it in other tasks.

Acknowledgement

This work is partially supported by ISTC project B-1489.

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