Computer Exercise Medical Image Visualization : Medical Image Visualization and Processing

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Objectives

– Discover the Scientific Visualization Took Vtk
– Test several 3D medical data visualization methods
– Apply scientific visualization technique to medical data
– Create your own medical image viewer application

1 Environment Installation

This project use the following free, open source and multi-plateforms software tools :
– The Graphical User Interface libraray Qt
– The `Makefile`/Windows/Unix/Mac projects generator CMake
– The scientific data visualization C++ libraray Vtk

1.1 Qt Installation

Normally, Qt libraries are allready installed on the Computers.

1.2 CMake Installation

Check that `CMake` is not already installed on your computer.
If it is not installed, make a local installation :
– Crate a `local` directory in your home directory
– Follow the instructions at this address

1.3 Vtk Installation

Get the last version of VTk at this address and compile/install it carefully checking the option `USE_QVTK` in your local directory.

1.4 Test

Get the example code archive ExampleMedical.zip.
Use CMake to create a projet (e.g KDEvelopp project) with the given sources in the `build` subdirectory.
Compile and execute the subprojects `Medical1`, `Medical2` and `Medical3`.

> In the following, you can look at the code to help you with your application project.

1.5   Computer Exercise Application Skeleton

Download the following code achive and uncompress it in a proper directory.

Use CMake to generate a project. Compile and execute the project using the data `image01.mha` in the `data` subdirectory.

2   Getting Started

2.1   Application Skeleton

Execute the program `GICAOImageViewer` and give the first image of the `data` directory as parameter. You should obtain an image which looks like the following Figure :
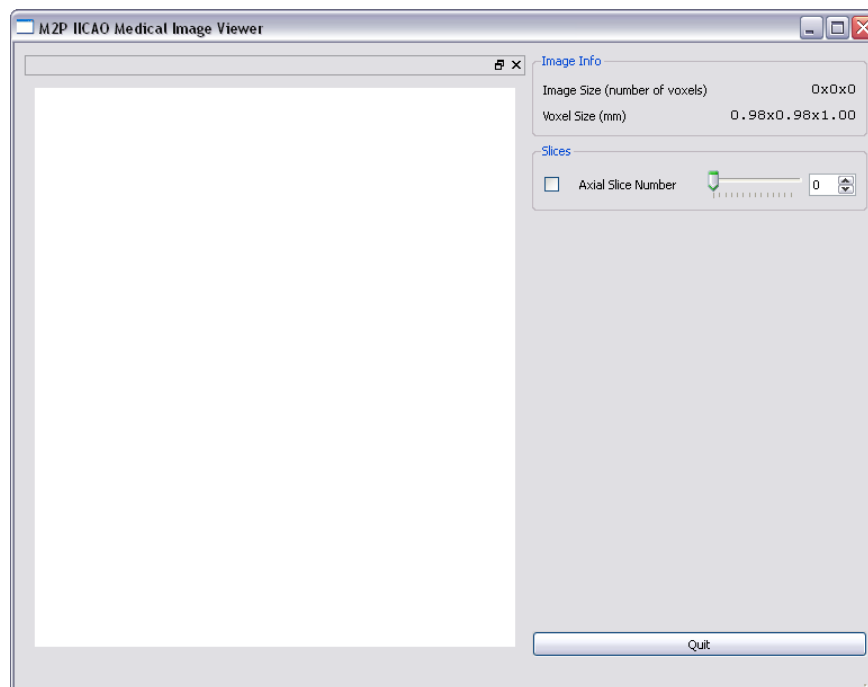

FIGURE 1 – Starting page you should obtain.

You will enhance the the applicaton you will modify the code of the class `MedicalViewer` in the files `MedicalViewer.h/cxx` as well as the Graphic User Interface (GUI) in the file `MedicalViewer.ui` with `QtDesigner`.

> The code you will write will mainly be performed with vtk. Do not hesitate to use and abuse of the library documentation here . You will also find example code source here.

The image contained in the file `image01.mha` is a volume image.
Open the file `image01.mha` in a text editor.

> *Question 2.1*
> What information are given in this file ?
> Where are the data ?
> How are they implemented ?

Start the `GICAOImageViewer` application and check the `Axial Slice Number` check-box. Change the slice number)either by the *slider* or with the *spin box*).

> *Question 2.2*
> What do you observe ? How have these images been obtained ? How can you perform this observation them (sketch an explicative figure) ?

In the file `MedicalViewer.cxx`, you can see that :
– the GUI initializatioin is made into 2 methods :
  – `ui.setupUi(this)` (Qt method) and
  – `initWindow()` (method of the class `MedicalViewer`) which creates a Vtk window in a Qt frame (if you want to change the background color, that's here !)
– Image reading is made by Vtk in the `readVolumeImage` method and the image volume is referenced in an attribute of the class `MedicalViewer`
– Once the image is read, information about the image format is updated in the `setImageInfo()` method.

> *Question 2.3*
> What information do the following attributes of the class `MedicalImageViewer` contain : `extent`, `spacing`, `origin` and `center`.

> *Question 2.4*
> What is the total size of the image in cm3 ?

3   Medical Image Slices

The present application only displays axial slices.

> *Question 3.1*
> Modify the application to allow to also visualize coronal and sagittal slices of the patient. You will thus carefully modify the GUI to display or not these new slices and to choose their numbers.

> You may want to add the following methods to the class Me-
> dicalViewer :
> – virtual void slotIsCoronalDisplaied(bool)
> – virtual void slotIsSagittalDisplaied(bool)
> – virtual void slotCoronalSliceNumberChanged(int)
> – virtual void slotSagittalSliceNumberChanged(int
>   )
> – void displayCoronalSlice(int sliceNumber)
> – void displaySagittalSlice(int sliceNumber)

Question 3.2
Sketch the corresponding vtk pipeline.

4   Medical Image Histogram

Several vtk classe allow to visualize an image histogram as illustrated
here.

> The class BarCharActor cannot represent more than 255 gray
> levels, which is not enough for the images we will use.

Question 4.1
Add to the application a window displaying the histogram of the open
image.

5   Medical Image Look Up Tables

Open the image image02.mha with the application

Question 5.1
Why does this image appears black ?

> Look at the image histogram.

Question 5.2
Modify the application so that the user can choose a mininum and a
maximum gray level for the Look Up Table.

Question 5.3
What does the image02.mha represent ? How was it obtained ?

Question 5.4
Modify the application to be able tu use different *colormaps*.