Implementation of Lightweight Graphic Library Builder for Embedded System

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***Abstract* — In this paper, we just glance at the Qt and GTK, which are representatives of graphic library for embedded linux system. And we also show what is the GTK+ in developing the software for the embedded system and its features and components. We describe the implementation of the lightweight GTK builder, which generates the proper graphic library to any special embedded linux system and also analyzes any GTK application's graphic library.**

***Keywords* — Lightweight, Qt, GTK+, Embedded System**

1. Introduction

Embedded software is very dependent to hardware of products because each product needs each feature different between them in view of its specification. Furthermore, even though software proper to the special CPU is developed it can't be supported to the other embedded system. So we need the embedded software developing technology, which should be independent to the various hardware features and be fast in developing the suitable embedded software.
Considering the point of view of developer, lastly used software is the graphic library. So traditionally, there are existed graphic libraries that are already fitted to the special embedded system, or from the first time, developed to be proper to the special system. In other words, today according to the embedded system, the graphic library is variously developed.

In general desktop linux system, so much used graphic libraries are QT and GTK+, what can be also used in embedded linux system because the embedded linux system is core of general desktop linux system. QT developed by Trolltech is not free, i.e. we have to pay the license fee for using QT, the other hand GTK+ is free, i.e. there is no license fee about GTK+, which is supported by Open Source Group.
This paper, according to the above, describes the generating technology of proper graphic library for the embedded system, and simultaneously should be independent to the embedded system. Specially, in this paper, we deal with the GTK+ 2.0 graphic library also in view of lightening graphic library.

2. Graphic Library

2.1 Qt

Qt is the graphic library that is developed by Trolltech. Qt is composed of widget sets based on K Desktop Environment (KDE) project. Any application used Qt is executed on any processor, if it is just re-compiled on that. That means Qt support the multi platform GUI. And it also support the not only 2D but 3D graphic and internationalization and XML, etc. Qt has the concept of signal –slot for communication between each objects.

By the way, Qt/Embedded is the customized graphic library, which is proper to the embedded system. Qt/Embedded also support the multiplatform GUI as like Qt. In other words, if it provided the C++ compiler and used the embedded linux, then it could be loaded on various platform such as X86, MIPS, ARM, StrongARM, Motorola 68k and PowerPC. Continuously, it is developed for supporting QNX and/or WinCE.

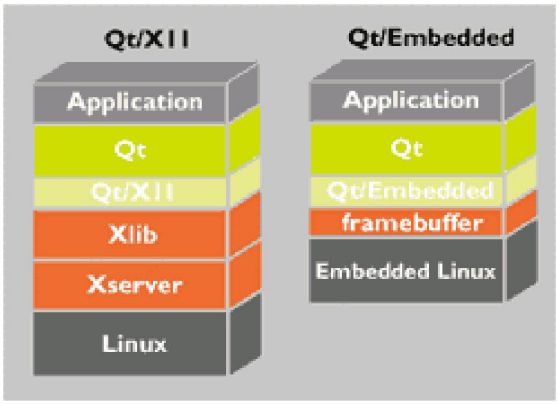

Figure 1. Structure of Qt/X11 and Qt/Embedded

Figure 1 show the comparison of structure of Qt/X11 and Qt/Embedded. Qt/Embedded has more compacted its own window system than Qt/X11 has one. Also Qt/Embedded can execute the application just to access directly to the frame buffer of kernel.

2.2 GTK+

GTK+ was originated from some widgets set, that is a toolkit for x window based GNU Image Manipulation Program (GIMP). GTK+ is a multiplatform graphic library to support the linux system, windows, BeOS, etc. and to support a range of languages, C/C++ but Perl, Python. And GTK+ is free software and part of the GNU Project. However, the

licensing terms for GTK+, the GNU Legacy General Public License (LGPL), allow it to be used by all developers, including those developing proprietary software, without any license fees or royalties.

GTK+ 2.0 is providing richer widget sets than GTK 1.2 and improving the existing widget set as like integration of gdk-pixbuf. Also Pango is a library for layout and rendering of text, with an emphasis on internationalization. It forms the core of text and font handling for GTK+ 2.0.

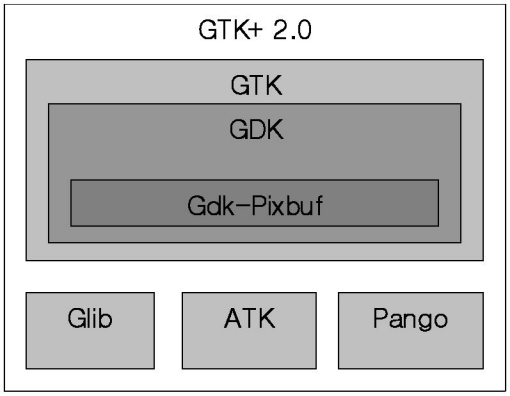

Figure 2. GTK+ 2.0 Structure

Figure 2 shows the structure of GTK+ 2.0. GTK+ is composed of the various graphic libraries which are Glib, ATK, Pango as for external library and GTK itself that is also composed of internal library - GTK, GDK, GdkPixbuf. The widget is basic component of GTK+ and GUI.

2.2.1 GTK+

GTK+ library itself contains widgets, that is, GUI components such as GtkButton, GtkVBox, GtkTextView, etc.

2.2.2 GDK

GDK is the abstraction layer library, which allows GTK+ to support multiple windowing systems. This library also provides drawing and window system facilities on X11, Windows, and the linux framebuffer device.

2.2.3 Gdk-Pixbuf

Gdk-Pixbuf is a small library that allows us to create pixel buffer objects from image data and/or image files. Mostly we use this library in combination with GtkImage to display images.

2.2.4 Glib

Glib is the low-level core library, which forms the basis of GTK+ and GNU Network Object Model Environment (GNOME). It provides data structure handling for C, portability wrappers, and interfaces for such runtime functionality as an event loop, threads, dynamic loading, and an object system.

2.2.5 ATK

ATK library provides a set of interfaces for accessibility. By supporting the ATK interfaces, an application or toolkit can be used with such tools as screen readers, magnifiers, and alternative input devices.

2.2.6 Pango

Pango is a library for layout and rendering of text, with an emphasis on internationalization. It forms the core of text and font handling for GTK+2.0.

2.3 Scope

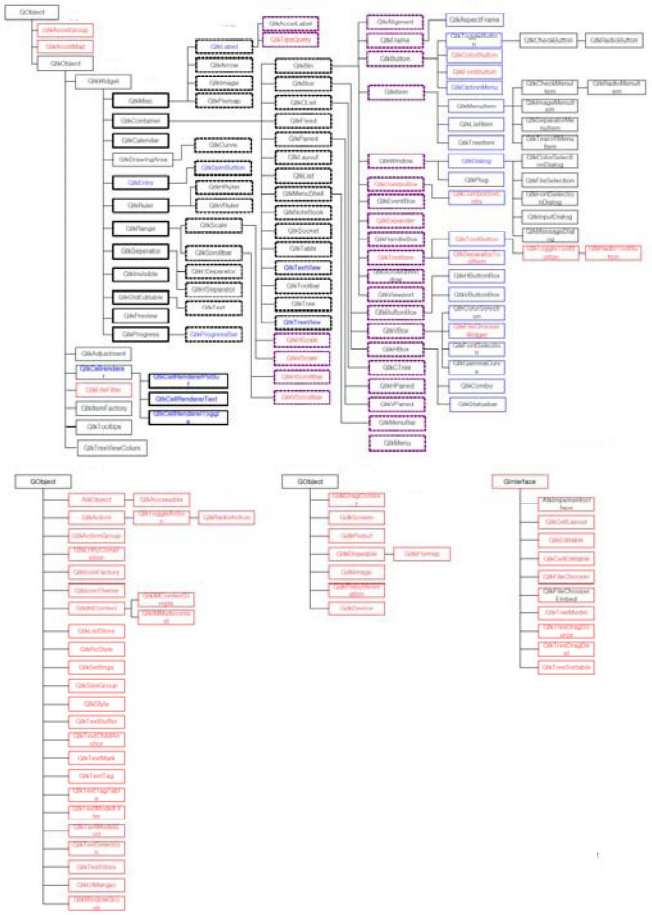

Figure 3. Hierarchy of GTK+ widget

Figure 3 shows the hierarchy of GTK+ widget set, which we are dealing with. In other words, to reduce the GTK+ widget set, we can get the lightweight GTK library. And that is proper to the applications of embedded system. Because mostly GTK widget set has lower dependency than other library as like Glib, ATK, Pango. So in this paper, we just focus on the GTK+ widget.

Furthermore, it is easily extended to the higher version of GTK+, above the 2.0, even though there is no compliant between GTK+ 2.0 and 1.2.

3. Lightweight GTK Builder

3.1 Structure

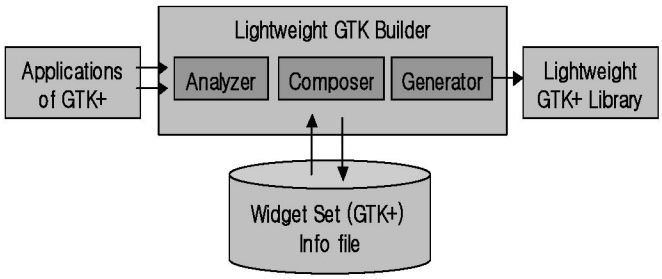

Figure 4. Structure of Lightweight GTK Builder

Figure 4 is structure of lightweight GTK builder and GTK+ structure. That is composed of the GTK+ information database and lightweight GTK generating part. So we can easily get the lightweight GTK library, which is proper to the embedded system. This GTK builder has three main modules that are analyzer, composer and generator. Analyzer has the function of analyzing GTK application. Composer ha the function of composing the GTK widgets according to the GTK information from database. Finally, generator has the function of compiling and linking the composed widgets set and eventually generates the customized lightweight GTK library.

3.1.1 Analysis Module

Analyzer gets the applications of GTK and /or GTK library as input value. So in this module, we can know the GTK widget set of applications and their dependency. Of course, the analyzing process is done automatically, if we just chose the applications on the lightweight GTK builder. Also manually we choose the widget components. Finally, that information is saved as info-file.

3.1.2 Compose Module

In this module, according to the analyzed info-file, real GTK widget set will be gathered from original GTK widget set. So we can see the information of each widget as like widget size, definition, and total size. They are all shown on lightweight GTK builder window.

3.1.3 Generation Module

Finally, this module generates the lightweight GTK library. In this time, this module refers the info-file of selected widget sets and compile/link information. And also its history is saved. We can see the procedure of GTK widget linking through the GTK builder's bottom window.

3.2 Screen shot

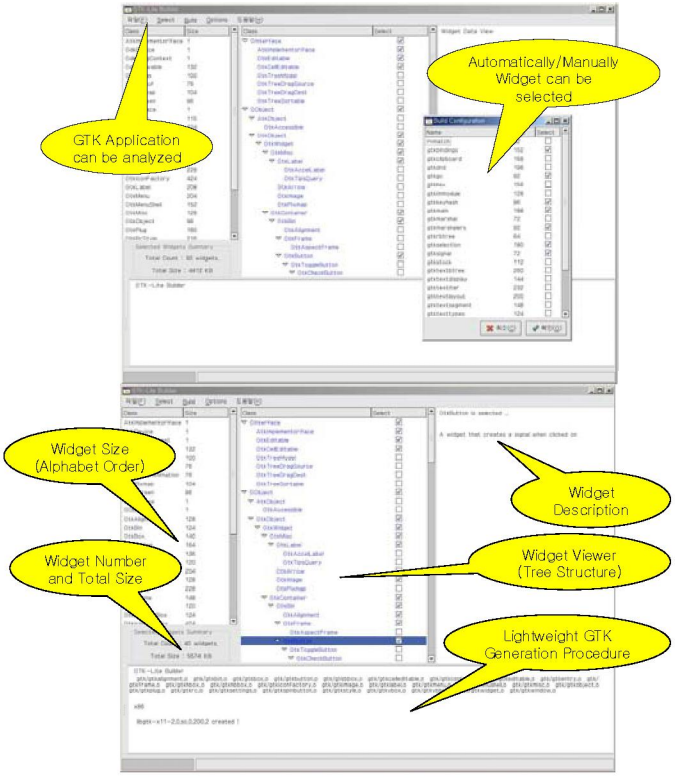

Figure 5. Screen Shot of Lite GTK Builder

Figure 5 shows the screen shot of lightweight GTK builder. As like upper-side figure, we can analyze the GTK application with lightweight GTK builder. That is, this builder open and read any GTK application and extract the informations of GTK library and save the file. And we will see the list of widget set through the build configuration window. In this time, we can manually also select and/or discard the widget set. In this lower figure, left-side window describe the each size of GTK widgets and these are also sorted alphabet order and also show the total size and number of widgets. Centered window show the hierarchy of widget set visually as like tree-structure. Right-side window describe the technical information of selected widget and its definition and usage. Bottom window show the processing of linking and compiling of widget set. Of couse, we can easily update the GTK info-file according to the GTK version-up.

4. Conclusion

In this paper we describe the generating system of lightweight graphic library for embedded linux system. With this product, developer can easily not only implement the customized graphic library but also analyze the some application of GTK. Furthermore, we will deal with the GTK+ itself but also external library of GTK+ for lightweight graphic library.

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