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An Overview of *Yy* and *YyonX* – A CLOS based Window Tool Kit and its Implementation –

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Abstract

Yy is a portable window tool kit on top of Common Lisp. Yy was originated in the needs for a common window system.

Yy is outlined as 1) a three level layered model; YYAPI (application interface), YYWS (window system) and NWSI (Native window system interface). 2) a window tool kit or UIMS on top of other general window system: Yy is not a competitive new window system. 3) a CLOS oriented system for both internal architecture and user interface. 4) a presentation system and an output recording facility.

YyonX is an implementation of Yy on X-window. The pilot of YyonX is already working.

It uses a server/client model. The protocol is defined for communication between a server and a client. Yy-server is a X-client for NWSI and low level stuffs of YyWS. Yy-client is a X-client for high level stuffs of YyWS and YYAPI. In the paper the design of basic classes and generic functions for Yy and its look and feel are also introduced.

1 Background 1 : Needs for a Window System in Common Lisp

There are several Window Systems and UIMS for various Common Lisp implementations. But they have different functionalities. With this reason, though the portability of Common Lisp is proven, lots of interactive and/or graphical applications can not be ported to different implementations easily.

From 1984 on, there have been several Common Lisp based standardization efforts including window systems. In the beginning, the Common Windows of Intellicorp was one of the candidate for standard but was not adopted. At that time, Symbolics Lisp machine did provide the Dynamic Window which features the presentation system. Common Windows itself grew and several dialects of it were introduced.

We made surveys and got a sketch as follows:

1) Trial to integrate several existing window systems into one is required. It should be independent from any existing windows but should have a bridge from them.

2) Consultation with the current technology is required. At least, X-window and it's friends, Common Windows, Genera, and PC-based windows should be investigated.

3) Public acceptance of the superiority of Dynamic Windows feature should be checked.

4) Good environment needs large memory. Is it affordable ? Say, a full function programming environment may occupy 20 M bytes or more.

5) As a workstation, much more functionality on Japanese character handling in every text handling is required.

2 Background 2 : CLOS and Object Oriented Approach

Recently it is quite common to integrate a windowing stuffs using object oriented idea. This trend has a firm technical background. Smalltalk is one example. In the Lisp world, Flavors is used as a kernel technology for Symbolics Genera Window system.

Recent development of CLOS (Common Lisp Object System), and its adoption as a part of X3J13 Common Lisp, place Common Lisp among the family of object oriented languages. Since CLOS (chapter 1 and 2) was established in 1988, there are not so much experience reported yet.

Lots of existing window systems for Common Lisp lack of object oriented approach since they were born before CLOS was invented. To CLOSify a portable window system is a must.

3 Analysis of Requirement Issues

Issue 1. Single Process or Multi Process

▷ discussions: Related questions are whether each window is assigned an independent process or is assigned to a window of native window system or no.

▷ conclusions:

1) Place a root window at initialization. Each window is a child of it.

2) Each window can be assigned a process.

3) Keyboard and Mouse events should be correctly and promptly handled.

4) "Pure Multi Process" is not needed. (Each window is not needed to be independently executed)

Issue 2. Object-Oriented Style

▷ discussions: CLOS is a must from the background requirement.

▷ conclusion:

1) User interface and window handling should be CLOS based both.
2) Window can be dynamically defined.
3) Try to evaluate the CLOS power. Try to check whether Meta Object Protocol give us a solution or not.
4) Migration path from other object oriented windowing tools is needed.

Issue 3. What is the Displayed Output.

▷ discussions: We discussed about what is the major advantage of Genera window system. One thing to prove is whether presentation system is affordable. In Genera, output is recorded as much memory as exists. (user can clear the history freely). Is infinite recording really necessary considering the space consumption and redisplay speed. Should all the object be mouse sensitive items? Context dependent mouse sensitivity is affordable or no.

▷ conclusions:

1) Must install output recording mechanism. Should provide a constant which has the maximum numbers of lines/items. (we all agree with the output recording feature is useful though it is heavy. need some purging mechanism.)
2) Presentation type is very important. Prepare the facility to get user defined presentation type. A new definition using CLOS named presentation class is introduced.
3) Sensitivity control considering the mouse speed should be needed.

Issue 4. Font and Multi National Character Presentation

▷ discussions: Japanese characters should be handled. Can display several fonts in the window or no. Two things to consider are, a case for multi-font strings and a case for alignment / pitch control of displayed characters with variable fonts.

▷ conclusion:

1) Provide multi font ability, though font itself is implementation dependent. The mechanism for it can be standardized.
2) Must consider the provision for dynamic adjustment of displayed characters with various fonts.

Issue 5. Widgets or Accessories

▷ discussions: Lots of window systems have lots of widgets/gadgets and independent styles. User friendliness comes from a uniformity of operations.

▷ conclusion:

1) Too much consideration for style guiding is not needed.
2) Coordination with Existing Styles or the styles of native window systems is needed.

Issue 6. Input Editor

▷ discussions: We discussed about the needs for input front-end processor (in a broader sense), Input Editing and Japanese character input mechanism as an example. There exist several Japanese character front-ends. Wnn, egg, or commercial front-end package, should co-exist with our new window at least with flexibility.

▷ conclusion: There must be a common way to access the stream internal buffer to alternate the character already input to that input stream.

Issue 7. Graphics Functions

▷ discussions: Provide rich functionality ? 3D model is needed ? Color handling is needed ?

▷ conclusion: The Lisp window system we are thinking doesn't provide high level graphic tools, but a typical level ones. Must provide color capability.

Issue 8. Implementation Model

▷ discussions: Is network oriented implementation needed ?

▷ conclusion: We don't need to specify the model details, since the target machines have much variety.

Issue 9. A New Window System or a Tool Kit on Top of other Windows

▷ discussions: Creating a new window system is attractive solution for the above. On the other hand, if we start to develop a new window system from scratch, we might need to develop every codes which should cope with the same functionality as other windows will have in every minutes.

We want to share the progress of window technology as a user of other window systems.

▷ conclusion: We will design and provide a window tool kit or user interface management system on top of various general purpose window systems.

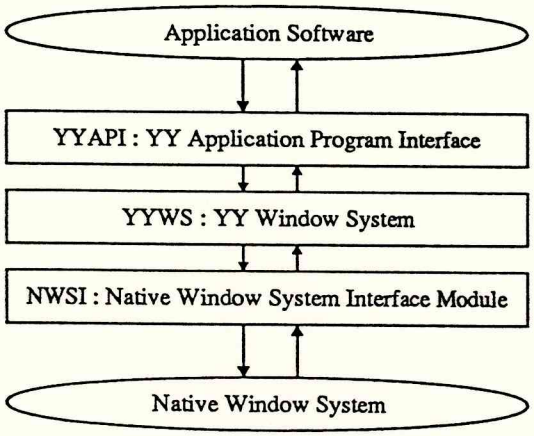


Figure 1: *YY* Layered Model

4 The Design of *YY Window Tool Kit* as a Conclusion of the above Analysis

YY Window Tool Kit is the goal of our analysis and is an output of our research works. As a summary, *YY* is a CLOS based window tool kit with our scheme of output recording. We design the *YY* as a layered tool kit with three levels; NWSI, *YYWS*, and *YYAPI*.

NWSI: Native Window System Interface Module

YYWS: *YY* window system

YYAPI: *YY* Application Program Interface

Figure 1 shows the model. NWSI depends on a native window system. *YYWS* is a native window independent window system and manages all the window objects. The interface between *YYWS* and NWSI is defined to be independent from various underlying window systems as possible. *YYAPI* (Ida, 1989) is an Application Program Interface and is used by the users.

5 *YYonX* as an Implementation of *YY Window Tool Kit*

5.1 The Server-Client Model of *YYonX*

YYonX is a ***YY Window Tool Kit*** on top of X-window, and is implemented as a pilot.

The three layers of ***YY Window Tool Kit*** are implemented by server-client model shown in Fig.2. *YY-server* is a server for ***YY Window Tool Kit*** . *YY-client* is a client. All the window operations are done by the cooperation of these two process.

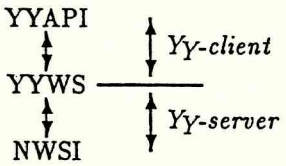


Figure 2: Implementation of *Yy* with a server-client model

Yy-server has two parts; The device dependent part and the device independent part. The device dependent part is a NWSI for X-window. The device independent part is a kernel of *YyWS*.

Yy-client has two parts; the application part of *YyWS* and the YYAPI.

Yy-server and *Yy-client* are implemented as X-clients. Then, they can be loaded on separate machines on the network. There is *Yy* protocol defined in (YY Project, 1989).

5.2 Running Environment

To run *YyonX* the following requirements should be satisfied.

1) Full Common Lisp, 2) X window R11, 3) CLOS implementation (as a pilot implementation, use PCL)

6 Characteristic concepts of *YyonX*

6.1 Meta Coordinate system

The coordinate system of X window has the origin at the top-left corner. While, many graphics systems have the origin at the bottom-left corner. To provide a flexibility on selecting the coordinate system in application software, user can choose which origin is suitable at the time of window creation. Since this feature uses the inheritance switching, all the selections are done at the initialization stage, there is no overhead on run time.

6.2 Output Recording and its Dynamic Control, Presentation

YyonX has an output recording and a presentation system. The basic components of presentation system are implemented as CLOS classes. Our presentation system is simpler than Symbolics' one. There is no implicit inheritance. The maximum number of recorded objects is controlled by a special constant.

Presentation system provides a mechanism to accept an output recorded object on the screen rather than typing the same thing. Since ***Yy Window Tool Kit*** has a mouse-still concept at the kernel level and is used to trigger an inspection procedure asynchronously, placing a mouse to a candidate for

a certain short period triggers to check the class and place a wire rectangle around it if it is a successful candidate. If it is the user's choice, clicking it accepts it as an object to input.

6.3 Functionality level which is equivalent to Common Windows

As many feasible drawing primitives as possible will be provided. The functionality level of *YyonX* application programmer interface is arranged as an equivalent to Common Windows.

6.4 Input Editor and Multi-National Features

One of the problem is which font is assumed to display multi-national characters. As for japanese characters, there are several ways to provide japanese character fonts. The font set for *YyonX* is selectable.

As for Japanese text input front-end, *YyonX* can switch between a custom made front-end and a Wnn Jserver.

Mini buffer is provided for input editing.

As for character font manipulation, character data type of Common Lisp has an attribute for it, and we will follow the update compiled by X3J13.

6.5 Distribution of the Loads

Server/Client model enables a distribution of the CPU and memory loads into two machines. Fig.3 shows a case for three machines' co-operation. Machine A and Machine B communicates with X-protocol. Machine B and Machine C communicates with *Yy*-protocol. With this configuration, actual application is supposed to be on machine C, and Japanese input front-end which sometimes needs heavy loads on CPU and memory can be separated from actual application on C.

Yy-protocol uses 4 byte unit packets to communicate. It includes all the functions with compact representation. Currently we have 48 instructions and three types. Intermittent synchronization feature enables asynchronous operations of the both sides. For minimum case, only 12 bytes are necessary to command. *Yy* protocol is designed to reduce the network traffic without degrading the functionality.

7 Primitive Classes

7.1 Position and Region

Position and Region are the most primitive classes in *YyonX* . Position is an object for a position in XY coordinates. Region is an object for a rectangular area.

Region has six slots logically; :top, :bottom, :left, :width, :height, and :right.

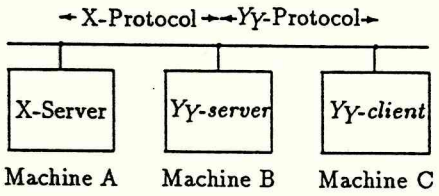


Figure 3: A Maximum Case for *Yy* Execution Environment

Region can be handled with LBRT (left-bottom-right-top) concept or LBWH (left-bottom-width-height) concept as user likes it.

7.2 Active-Region

Active-region is mouse-sensitive region. Several mouse-methods like enter-region, exit-region, are provided.

This active-region mechanism is completely independent and different from presentation. With active-region, user may define arbitrary rectangle.

7.3 Stream

Input and output with ***Yy Window Tool Kit*** are through the streams. The implementation is done with CLOS, and is an extension of stream type conforming David Gray's proposal to X3J13.

The primary streams are a `graphic-stream` and its two sub classes named `window-stream` and `bitmap-stream`.

On the other hand, `event-stream` is provided to support the handling of asynchronous input events. Mouse cursor movement, button clicking information, event status, and keyboard interruption are passed via event-stream.

7.4 World, Viewport and Page

The region which is a subject to display is called a world. The part of world which is appeared on the screen is called viewport. Page is for a fixed width world.

7.5 Stipple

The target of `bitmap-stream` is called stipple. Object can be transferred between stipple and world.

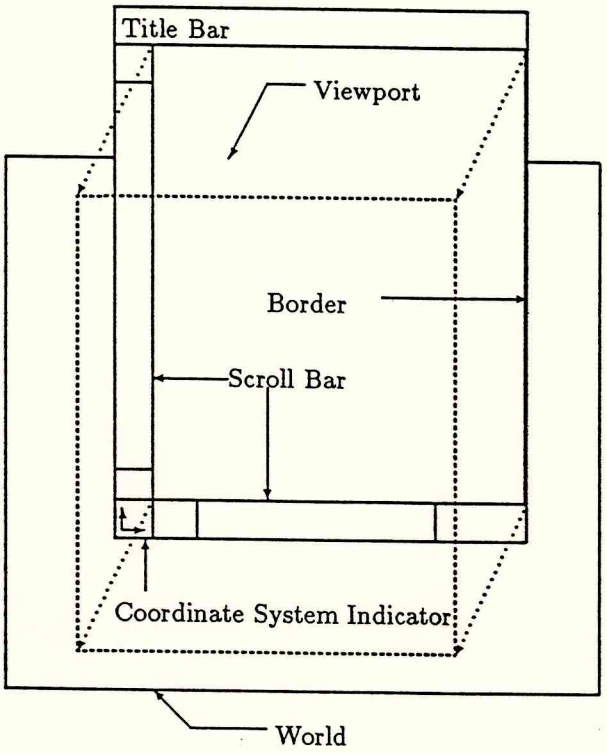


Figure 4: World, Viewport and Window

7.6 Class management in *YYWS*

In *YYWS*, all the windows, window components and presented outputs belong to classes. These classes have several multiple inheritance relations.

Region class is used as one of the most primitive classes and is inherited by several window classes. As its nature, class inheritance is used to provide a module/procedure library.

8 Window Stuffs

8.1 The Structure and the Operations for Window

Window is composed of title and frame. Title might not exist. Accessories can be attached to title and frame. A frame is a viewport or a page. The edge of frame can have a width and is called border. Frame supports scrolling. Viewport scrolling is possible for top-bottom and left-right. Page scrolling is only possible only for top-bottom. Fig.4 shows the relation between world, viewport and window. Coordinate system indicator is for the

meta coordinate system. The indicator of Fig.4 example shows the origin is the left-bottom.

Window class definition has slots to describe parent relationship and sibling relationship. The root is a root window.

Window has a rectanglar area and is composed of title-bar, border, scroll bar, coordinate system indicator area, and frame. Viewport or page is mapped to frame.

Both graphic drawing and text display are permitted on viewport. Top-bottom and left-right scrolling are allowed on viewport.

On the otherhand, Left-right scrolling is not permitted for page. The usage of page is assumed as interaction buffer like a lisp listener or a emacs editor buffer which can be defined as a fixed width roll paper. To achieve high speed display on page, graphic drawing on page is not considered.

8.2 Window Creation and Drawing

Window class has a slot to indicate whether the window is visible or no. This value is determined at creation.

The size of window in a screen can be determined by user. The width and height of a frame are determined at creation. The default size of a world is initially assigned to the same value as its viewport. The default width of a border is 1 dot. The width of title bar is the same as window width. The height of title bar depends on the height of fonts for title characters.

Whether title, scroll bar and coordinate system indicator appear or no can be controlled. Most of the controlling parameters stored in the slots of window instance are dynamically changeable.

On the initial start up of *YyonX*, a root window is created and displayed. a guide window is then appeared as shown in Fig. 5. The root window and the guide window have no title bar, scroll bar, and coordinate system indicator displayed.

8.3 Icon

Icon is a display symbol which means a window is dormant. The window which is displayed as an icon is drawable. But the contents are not displayed.

8.4 Drawing to a Window

Drawing with drawing primitive is done through a graphic stream object. If the window stream class, which is a subclass of the graphic stream, is used, drawing is done to a world. If the bitmap stream class, which is another subclass of the graphics stream, is used, drawing is done to a stipple. Graphic primitives like drawing a line or a circle, and text displaying primitives are provided. Common Lisp standard input/output primitives can direct data to the window stream in *YyonX*.

Drawing to a window is to add an additional 'drawing instance' to a slot of the world instance. It means *YyWS* has no bit plane which corresponds to each window.

9 Pop up Menu Operations

Window creation invokes the set up of accessories by default. The default accessory is a pop up menu for mouse right button. With this pop up menu, window operation can be selected.

For windows other than the root, Pressing a mouse button at the title bar or border triggers to display a pop up menu. This menu offers a choice among the operations corresponding to each menu items. The pop up menu for the root window is on its frame. This menu has a same functionality as the above pop up menu, but an selecting a window operation added. The following is the list of methods on pop up menu.

Move method: This method moves the position of a window.

Reshape method: This method changes the size of a window. The size of each components of a window is changed but still kept displayed.

Expose method: This method places a window on top the window occlusion stack. The window is displayed as the top and the whole contents of it are displayed.

Bury method: This method places a window on the bottom of the window occlusion stack. The window is displayed as the bottom. The part which is placed under other windows is not visible.

Flush method: This method removes a window instance and several objects which are owned by it. These window instances are disappeared from screen.

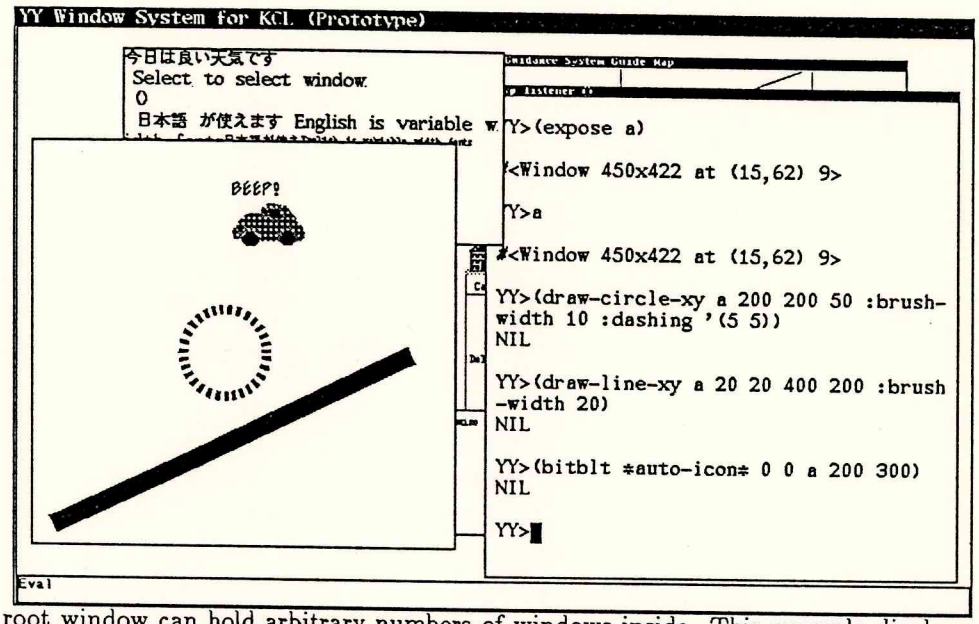
Clear method: This method clears the contents of a window and the world which is connected to the frame.

Shrink method: This method removes a window from the screen and creates and displays an icon instead.

Expand method: This method removes an icon from the screen and displays the corresponding window. The window still has the same attribute as it has before. The window is displayed at the proper place, keeping its sibling relation.

10 To use *YyonX*

YyonX is started by `Initialize-yy` command. This makes a root window displayed. A root window is a window of X window. So every X window handling is applied to the root window. Fig. 5 shows an example. Multiple worlds can be handled in one root window. Multiple root window can be invoked at the same time. They are assigned different processes. The communication between them should be explicitly directed by the user.



A root window can hold arbitrary numbers of windows inside. This example displays four windows. One Lisp listener window is automatically appeared.

A root window always have a guide window at the bottom. The guide window is used by input editor, system warning/guiding message, Japanese text input front-end and so on.

Figure 5: An example display of *YyonX*

A root window always have a guide window at the bottom. A guide window is used by input editor, system warning/guiding message, Japanese text input front-end and so on. A Lisp listener window is automatically prepared. On calling editor, GnuEmacs is invoked with the user's normal initialization.

Scroll bar and standard popup menu are provided for each window. For viewport frame, bars are appeared on the left and the bottom. For page frame, bar on the left is appeared. Standard popup menu contains primitive operations like Shrink (Expand), Move, Reshape, Clear, Expose, Bury. Furthermore, root window is given a menu of special operations to handle whole window.

11 Development Status

The development of *YyonX* started on April 1989. On October 1989, the prototype started to work.

We are evaluating the server-client model of us. With the server-client model, *YyonX* splits a Lisp application into two. It enables the reduction of CPU load and memory load of one machine. Application software can fit with smaller machines than 'all-in-one' window tool kit.

Acknowledgement

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