MUI - MagicUserInterface

A system to create and maintain graphical user interfaces

- Programmer Documentation -

Version 1.4
19-Oct-1993

Stefan Stuntz

1 Getting Started

Note: This documentation does not cover all concepts of MUI programming in detail. It's important that you also read the accompanying per class autodocs and have a look at the supplied demo programs!

1.1 Object Oriented Programming

The MUI system is based on BOOPSI, the Basic Object Oriented Programming System for Intuition. Understanding MUI and understanding this documentation requires at least a little knowledge about the concepts of object oriented programming, about classes, objects, methods and attributes. An absolutely sufficient introduction to these topics can be found in the "Libraries" part of the "ROM Kernel Reference Manuals" or in several Amiga mail articles.

When talking about BOOPSI, most people automatically think of BOOPSI images and BOOPSI gadgets as part of the Amiga operating system. However, BOOPSI for itself is just a system for object oriented programming. One could e.g. have object oriented spread sheet software or object oriented file systems based on BOOPSI, intuition's builtin classes (gadgetclass, imageclass) are just two from thousands of possibilities.

The MUI system also uses BOOPSI only as a base for object oriented programming. Thus, MUI classes are all subclasses of BOOPSI's rootclass and have nothing in common with the system supplied gadget or image classes. Unfortunately, Commodore missed some very important topics when designing these classes, disabling them for use in automatic layout systems such as MUI. Anyway, MUI features an interface to BOOPSI's gadgetclass and allows using already available gadgets (e.g. the Kick 3.x colorwheel) in MUI applications.

1.2 Available Classes

The MUI system comes with several classes, each of them available as seperate shared system library. These classes are organized in a tree. As usual in the OO programming model, objects inherit all methods and attributes from their true class as well as from all their superclasses. Here is a quick summary with some short notes what the classes are used for. More detailed information can be found later in this document and in the per class autodocs files coming with the developer archive.

```
rootclass               (BOOPSI's base class)
\--Notify               (implements notification mechanism)
   +--Application       (main class for all applications)
   +--Window            (handles intuition window related topics)
   \--Area              (base class for all GUI elements)
      +--Rectangle      (creates empty rectangles)
      +--Image          (creates images)
      +--Text           (creates some text)
      +--String         (creates a string gadget)
      +--Prop           (creates a proportional gadget)
      +--Gauge          (creates a fule gauge)
      +--Scale          (creates a percentage scale)
      +--Boopsi         (interface to BOOPSI gadgets)
      +--Colorfield     (creates a field with changeable color)
      +--List           (creates a line-oriented list)
      !  +--Floattext   (special list with floating text)
      !  +--Volumelist  (special list with volumes)
      !  +--Scrmodelist (special list with screen modes)
      !  \--Dirlist     (special list with files)
      \--Group          (groups other GUI elements - handles layout)
         +--Virtgroup   (handles virtual groups)
         +--Scrollgroup (handles virtual groups with scrollers)
         +--Scrollbar   (creates a scrollbar)
         +--Listview    (creates a listview)
         +--Radio       (creates radio buttons)
         +--Cycle       (creates cycle gadgets)
         +--Slider      (creates slider gadgets)
         +--Coloradjust (creates some RGB sliders)
         \--Palette     (creates a complete palette gadget)
```

1.3 Application Theory

A MUI application consists of a (sometimes very) big object tree (don't mix up with the class tree explained above). The root of this tree is always an instance of application class, called application object. This application object handles the various communication channels such as user input through windows, ARexx commands or commodities messages.

An application object itself would be enough to create non-GUI programs with just ARexx and commodities capabilities. If you want to have windows with lots of nice gadgets and other user interface stuff, you will have to add window objects to your application. Since the application object is able to to handle any number of children, the number of windows is not limited.

Window objects are instances of window class and handle all the actions related with opening, closing, moving, resizing and refreshing of intuition windows. However, a window for itself is not

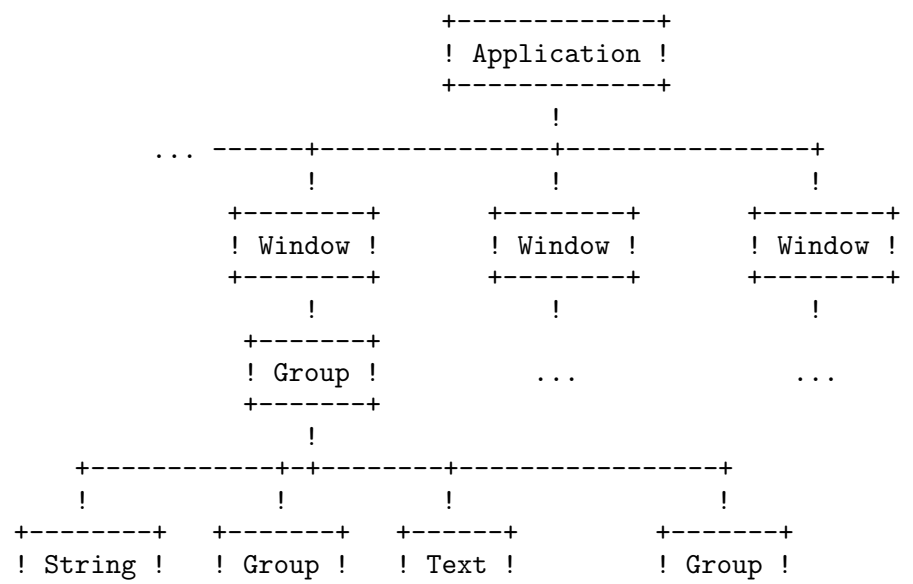
of much use without having any contents to display. That's why window objects always need a so called root object.

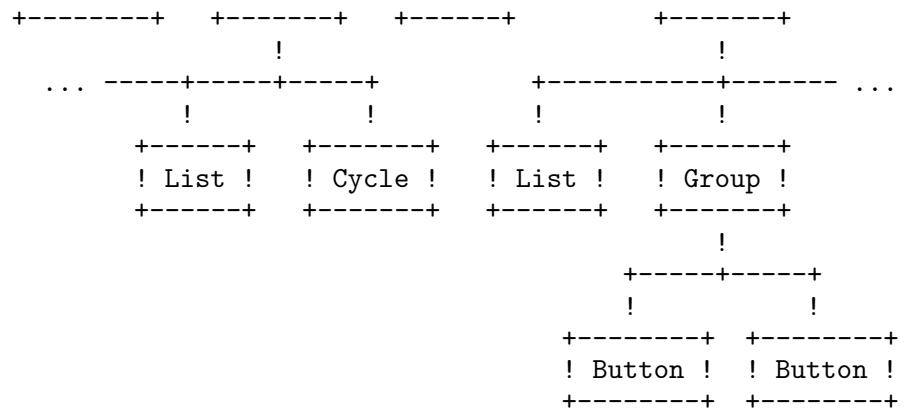
With this root object, we finally reach the gadget related classes of the MUI system. These gadget related classes are all subclasses of area class, they describe a rectangle region with some class dependant contents. Many different classes such as strings, buttons, checkmarks or listviews are available, but the most important subclass of area class is probably the group class. Instances of this class are able to handle any number of child objects and control the size and position of these children with various attributes. Of course these children can again be group objects with other sets of children. Since you usually want your window to contain more than just one object, the root object of a window will be a group class object in almost all cases.

Because these first paragraphs are very important to understand how MUI works, here's a brief summary:

An application consists of exactly one application object. This application object may have any number of children, each of them being a window object. Every window object contains a root object, usually of type group class. This group object again handles any number of child objects, either other group objects or some user interface elements such as strings, sliders or buttons.

A little diagram might make things more clear:





As shown in this tree, only three types of objects are allowed to have children:

```
Application: zero or more children of window class.
     Window: exactly one child of any subclass of area class.
      Group: one or more children of any subclass of area class.
```

1.4 Object Handling

Since MUI uses BOOPSI as object oriented programming system, objects could simply be created using intuition.library/NewObject(). However, '`muimaster.library`' also features a generation function called

```
Object * MUI_NewObjectA(STRPTR class, struct TagItem *taglist);
```

with the varargs stub

```
Object * MUI_NewObject(STRPTR class, Tag tag1, ..., TAG_DONE);
```

That's the function you should use when creating objects of public MUI classes. The parameter '`class`' specifies the name of the object's class (e.g. '`MUIC_Window`', '`MUIC_Slider`', ...). If the needed class isn't already in memory, it is automatically loaded from disk.

With '`taglist`', you specify initial create time attributes for your object. Every attribute from the objects true class or from one of its super classes is valid here, as long as it's marked with the letter '`I`' in the accompanying autodocs documentation.

To create a string object with a string-kind frame, a maximum length of 80 and the initial contents "foobar", you would have to use the following command:

```
MyString = MUI_NewObject(MUIC_String,
               MUIA_Frame          , MUIV_Frame_String,
               MUIA_String_Contents, "foobar",
               MUIA_String_MaxLen  , 80,
               TAG_DONE);
```

Once your object is ready, you can start talking to it by setting or getting one of its attributes or by sending it methods. The standard BOOPSI functions '`SetAttrs()`', '`GetAttr()`' and '`DoMethod()`' are used for these purposes:

```
~  char *contents;
~  SetAttrs(MyString,MUIA_String_Contents,"look",TAG_DONE);
~  GetAttr(MUIA_String_Contents,MyString,&contents);
   printf("Always %s on the bright side of life.",contents);

DoMethod(mylist,MUIM_List_Remove,42); /* remove entry nr 42 */
```

As already mentioned above, all attributes and methods are completely documented in the autodocs coming with this distribution. These autodocs follow the usual format, you can parse them with one of the various tools to create some hypertext online help for your favourite editor.

When you're done with an object, you should delete it with a call to

```
VOID MUI_DisposeObject(Object *obj);
```

from '`muimaster.library`'. After doing so, the object pointer is invalid and must no longer be used.

When deleting objects, the parent-child connections mentioned above play an important role. If you dispose an object with children, not only the object itself but also all of its children (and their children, and the children of their children ...) get deleted. Since in a usual MUI application, the application object is the father of every window, the window is the father of it's contents and every group is the father of its sub objects, a single dispose of the application object will free the entire application.

Note well: you may **not** delete objects that are currently children of other objects. Thus, if you have a complete application tree, the only thing you can delete is the application object itself as

this one has no father. You can, however, add and remove children dynamically. More information on that topic follows later in this document.

1.5 Macros

This chapter is only valid if you use C as your MUI programming language. Other language interfaces might feature other types of macros or support functions. Please have a look at the supplied interfaces to see how they work.

The tree structure that builds up an application also appears in the source code of a MUI program. Since adding child objects is always possible with a special attribute of the parent object, it is common to create the whole tree with one big function call.

To help making these calls more clear, the MUI header files contain several macros that simplify the task of object generation.

Instead of

```
MUI_NewObject(MUIC_Window, ..., TAG_DONE);
MUI_NewObject(MUIC_String, ..., TAG_DONE);
MUI_NewObject(MUIC_Slider, ..., TAG_DONE);
```

you can simply use

```
WindowObject, ..., End;
StringObject, ..., End;
SliderObject, ..., End;
```

Please note that the '`xxxObject`' macros contain an opening bracket and thus must always be terminated with an '`End`' macro that contains the matching closing bracket.

Besides these "two way" macros, there are also some complete object definitions available which all create specific objects with certain types of attributes. The macro

```
SimpleButton("Cancel")
```

would e.g. generate a complete button object with the correct frame, background and input capabilities. Though lots of these types of macros are available and can of course be used directly in

your applications, they are mainly intended as some kind of example. Usually you will need some more sophisticated generation capabilities with a more specific set of macros.

Note: If your application needs lots of objects from a specific type (e.g. 200 buttons), you can save some memory by turning macros into functions.

2 Layout Engine

2.1 Overview

One of the most important and powerful features of MUI is its dynamic layout engine. As opposed to other available user interface tools, the programmer of a MUI application doesn't have to care about gadget sizes and positions. MUI handles all necessary calculations automatically, making every program completely screen, window size and font sensitive without the need for the slightest programmer interaction.

From a programmers point of view, all you have to do is to define some rectangle areas that shall contain the objects you want to see in your window. Objects of group class are used for this purpose. These objects are not visible themselves, but instead tell their children whether they should appear horizontally or vertically (there are more sophisticated layout possibilities, more on this later).

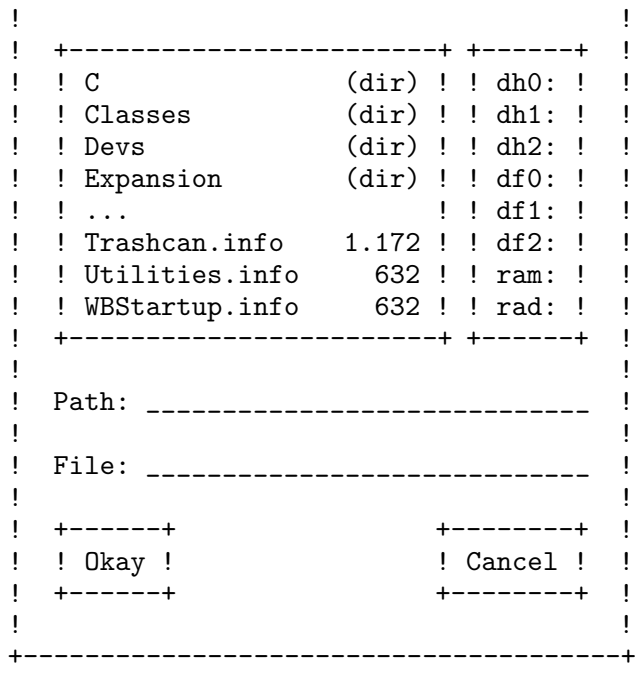
For automatic and dynamic layout, it's important that every single object knows about its minimum and maximum dimensions. Before opening a window, MUI asks all its gadgets about these values and uses them to calculate the windows extreme sizes.

Once the window is opened, layout takes place. Starting with the current window size, the root object and all its children are placed depending on the type of their father's group and on some additional attributes. The algorithm ensures that objects will never become smaller as their minimum or larger as their maximum size.

The important thing with this mechanism is that object placement depends on window size. This allows very easy implementation of a sizing gadget: whenever the user resizes a window, MUI simply starts a new layout process and recalculates object positions and sizes automatically. No programmer interaction is needed.

2.2 Groups

As mentioned above, a programmer specifies a windows outfit by grouping objects either horizontally or vertically. As a little example, lets have a look at a simple file requester window:



This window consists of two listview objects, two string gadgets and two buttons. To tell MUI how these objects shall be placed, you need to define groups around them. Here, the window consists of a vertical group that contains a horizontal group with both lists as first child, the path gadget as second child, the file gadget as third child and again a horizontal group with both buttons as fourth child.

Using the previously defined macro language, the specification could look like this (in this example, '`VGroup`' creates a vertical group and '`HGroup`' creates a horizontal group):

```
VGroup,
   Child, HGroup,
      Child, FileListview(),
      Child, DeviceListview(),
      End,
   Child, PathGadget(),
   Child, FileGadget(),
   Child, HGroup,
      Child, OkayButton(),
      Child, CancelButton(),
      End,
   End;
```

This tiny piece of source is completely enough to define the contents of a window, all necessary sizes and positions are automatically calculated by the MUI system.

To understand how these calculations work, it's important to know that all basic objects (e.g. strings, buttons, lists) have a fixed minimum and a maximum size. Group objects calculate their minimum and maximum sizes from their children, depending whether they are horizontal or vertical:

- Horizontal groups
  The minimum width of a horizontal group is the sum of all minimum widths of its children.
  The maximum width of a horizontal group is the sum of all maximum widths of its children.
  The minimum height of a horizontal group is the biggest minimum height of its children.
  The maximum height of a horizontal group is the smallest maximum height of its children.
- Vertical groups
  The minimum height of a vertical group is the sum of all minimum heights of its children.
  The maximum height of a vertical group is the sum of all maximum heights of its children.
  The minimum width of a vertical group is the biggest minimum width of its children.
  The maximum width of a vertical group is the smallest maximum width of its children.

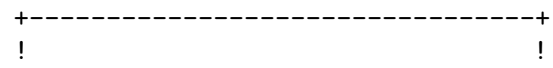
Maybe this algorithm sounds a little complicated, but in fact it is really straight forward and ensures that objects will neither get smaller as their minimum nor bigger as their maximum size.

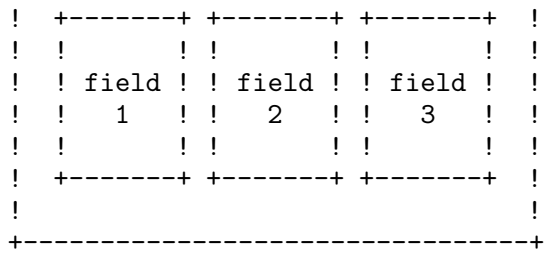
Before a window is opened, it asks its root object (usually a group object) to calculate minimum and maximum sizes. These sizes are used as the windows bounding dimensions, the smallest possible window size will result in all objects being display in their minimum size.

Once minimum and maximum sizes are calculated, layout process starts. The root object is told to place itself in the rectangle defined by the current window size. This window size is either specified by the programmer or results from a window resize operation by the user. When an object is told to layout itself, it simply sets its position and dimensions to the given rectangle. In case of a group object, a more or less complicated algorithm distributes all available space between its children and tells them to layout too.

This "more or less complicated algorithm" is responsible for the object arrangement. Depending on some attributes of the group object (horizontal or vertical, ...) and on some attributes of the children (minimum and maximum dimensions, ...), space is distributed and children are placed.

A little example makes things more clear. Let's see what happens in a window that contains nothing but three horizontally grouped colorfield objects:





Colorfield objects have a minimum width and height of one pixel and no (in fact a very big) maximum width and height. Since we have a horizontal group, the minmax calculation explained above yields to a minimum width of three pixels and a minimum height of one pixel for the windows root object (the horizontal group containing the colorfields). Maximum dimensions of the group are unlimited. Using these results, MUI is able to calculate the windows bounding dimensions by adding some spacing values and window border thicknesses.

Once min and max dimensions are calculated, the window can be opened with a programmer or user specified size. This size is the starting point for the following layout calculations. For our little example, let's imagine that the current window size is 100 pixels wide and 50 pixels high.

MUI subtracts the window borders and some window inner spacing and tells the root object to layout itself into the rectangle left=5, top=20, width=90, height=74. Since our root object is a horizontal group in this case, it knows that each colorfield can get the full height of 74 pixels and that the available width of 90 pixels needs to be shared by all three fields. Thus, the resulting fields will all get a width of 90/3=30 pixels.

That's the basic way MUI's layout system works. There are a lot more possibilities to influence layout, you can e.g. assign different weights to objects, define some inter object spacing or even make two-dimensional groups. These sophisticated layout issues are discussed in the autodocs of group class.

3 Building An Application

3.1 Creation

Creating all the objects that make up an applications user interface is usually done with one big '`MUI_NewObject()`' call. This call returns a pointer to the application object as its result and contains lots of other object creation calls as parameter for its tag items. Using the previously defined macro language, a sample generation call could look like this:

```
app = ApplicationObject,
   MUIA_Application_Title      , "Settings",
   MUIA_Application_Version    , "$VER: Settings 6.16 (20.10.93)",
   MUIA_Application_Copyright  , "©1992/93, Stefan Stuntz",
   MUIA_Application_Author     , "Stefan Stuntz",
   MUIA_Application_Description, "Just a silly demo",
   MUIA_Application_Base       , "SETTINGS",

   SubWindow, window1 = WindowObject,
      MUIA_Window_Title, "Save/use me and start me again!",
      MUIA_Window_ID   , MAKE_ID('S','E','T','T'),

      WindowContents, VGroup,

         Child, ColGroup(2), GroupFrameT("User Identification"),
            Child, Label2("Name:"  ), Child, str1 = String(0,40),
            Child, Label2("Street:"), Child, str2 = String(0,40),
            Child, Label2("City:"  ), Child, str3 = String(0,40),
            Child, Label1("Passwd:"), Child, str4 = String(0,40),
            Child, Label1("Sex:"   ), Child, str5 = String(0,40),
            Child, Label("Age:"),
            Child, sl  = SliderObject, End,
            End,

         Child, VSpace(2),

         Child, HGroup,
MUIA_Group_SameSize, TRUE,
            Child, btsave   = KeyButton("Save"  ,'s'),
            Child, btuse    = KeyButton("Use"   ,'u'),
            Child, btcancel = KeyButton("Cancel",'>'),
            End,

         End,
      End,
```

```
      SubWindow, window2 = WindowObject,
         MUIA_Window_Title, "Window 2",
   ...,
   ...,
   End,

      SubWindow,
   ...
   End,

      End;

   if (!app) fail(app,"Failed to create Application.");
```

This big structure is indeed one single function call that builds a lot of other objects on the fly. Windows are created as children of the application object, a windows contents are created as child of the window and a groups contents are created as children of the group.

Though many single objects are created, error handling is very easy. When a parent object encounters a NULL pointer supplied as one of its children, it will automatically dispose all other supplied children and fail too. Thus, even errors occuring in a very deep level will cause the complete application object to fail. On the other hand, if you receive a non NULL application pointer, you can be sure that all other objects have successfully been created.

Once you're done with your application, a single

```
MUI_DisposeObject(app);
```

is enough to get rid of all previously created objects.

3.2 Notificiation

The central element for controlling a MUI application is the notification mechanism. To understand how it works, its important to know that most objects feature lots of attributes that define their current state. Notification makes it possible to react on changes of these attributes.

Attributes are changed either directly by the programmer (with a call to SetAttrs()) or by the user manipulation some gadgets. If he e.g. drags around the knob of a proportional gadget, the MUIA_Prop_First attribute will continously be updated and reflect the current position.

With notification, you could directly use this attribute change to set the MUIA_List_TopPixel attribute of a list object, building up a full featured listview:

```
DoMethod(sbar, MUIM_Notify, MUIA_Prop_First, MUIV_EveryTime,
         list, 3, MUIM_Set, MUIA_List_TopPixel, MUIV_TriggerValue);
```

To make it clear: Every time, the scrollbar object changes its '`MUIA_Prop_First`' value, the list object shall change its '`MUIA_List_TopPixel`' attribute accordingly. The value 3 in the above function call identifies the number of the following parameters. Since you can call any method with any parameters here and MUI needs to save it somewhere, it's important to set it correctly.

From now on the list and the scrollbar are connected to each other. As soon as the proportional gadget is moved, the position of the list changes accordingly; the programmer doesn't have to care about.

Notification is mostly used with either the '`MUIM_Application_ReturnID`' or with the '`MUIM_CallHook`' method. If you e.g. have a specific hook that should be called whenever the user presses a button, you could use the following notify method:

```
DoMethod(button, MUIM_Notify, MUIA_Button_Pressed, FALSE,
         button, 2, MUIM_CallHook, &ButtonHook);

/* Whenever the button's pressed attribute is set to FALSE
   (i.e. the user has released the button), the button object
   itself will call ButtonHook. */
```

Futher information can be found in the autodocs of notify class.

4 Dynamic Object Linking

4.1 Overview

Usually, the complete user interface of an application is created with one single command. This makes error handling very easy and allows parallel usage of several windows. However, sometimes it makes sense to create certain windows only when they are actually needed: For example, if an application supplies many subwindows and would use too much memory, or if the number and contents of needed windows is not known at application startup time.

Therefore MUI supports the option of "late binding". Using this mechanism, children can be added and removed after their parent object already has been created. MUI uses the methods '`OM_ADDMEMBER`' and '`OM_REMMEMBER`' for this purpose:

```
DoMethod(parent,OM_ADDMEMBER,child); /* add child object    */
DoMethod(parent,OM_REMMEMBER,child); /* remove child object */
```

Both methods are only supported by MUI's application and group class; these are the only classes that can manage several children. Dynamic object linking for window and group class is explained in detail in the following chapters.

Note: Objects that do not have parents, be it, because they are not yet connected using '`OM_ADDMEMBER`' or because they were disconnected using '`OM_REMMEMBER`', it's the programmer's task to delete them by calling '`MUI_DisposeObject()`'. On the other side, objects that still are children of other objects must not be deleted!

4.2 Dynamic Windows

Let's say an application object is already set up and another (not yet existing) window has to be added. First, the window object needs to be created:

```
win = WindowObject,
   MUIA_Window_Title, "New Window",
      WindowContents, VGroup,
         Child, ...,
         Child, ...,
         Child, ...,
         End,
```

```
~     End,
   End;

if (!win) fail(); /* failure check */
```

After the window object is created, it can be added to the application as one of its children:

```
DoMethod(app,OM_ADDMEMBER,win);
```

Now this window has become a part of the application, just as if it had been created as a subwindow together with the application object. It can be opened and closed by setting the according attributes and will be deleted automatically as soon as the application is ended.

Usually, however, you'll want to delete this window directly after usage, because the late binding wouldn't make much sense otherwise.

After closing the window via

```
set(win,MUIA_Window_Open,FALSE);
```

you can remove it by calling

```
DoMethod(app,OM_REMMEMBER,win);
```

After this you have to delete the window object "by hand", since the application no longer knows of it:

```
MUI_DisposeObject(win);
```

This method makes it possible to create subroutines that open their own window, wait for some imput events und return something.

To illustrate this, here is a short example:

```
set(app,MUIA_Application_Sleep,TRUE);  // disable other windows

win = WindowObject, ...., End;         // create new window

if (win)                               // ok ?
```

```
{
    DoMethod(app,OM_ADDMEMBER,win);    // add window...
    set(win,MUIA_Window_Open,TRUE);    // and open it

    while (running)
    {
        switch (DoMethod(app,MUIM_Application_Input,&sigs))
        {
            ... // Extra Input loop. For this window only.
            ... // Note: The special value
            ... // MUIV_Application_ReturnID_Quit should be recognized
            ... // as well
        }
    }

    set(win,MUIA_Window_Open,FALSE);   // Close window

    DoMethod(app,OM_REMMEMBER,win);    // remove

    MUI_DisposeObject(win);            // and kill it
}

set(app,MUIA_Application_Sleep,FALSE); // wake up the application
```

4.2.1 Dynamic Groups

In the same way you can add windows to an application after its creation, you can add elements to already existing group objects. This may be useful if a group contains many similar children or if the number of children is not known in the beginning.

You can add new elements to groups or delete them again, but the window that contains this group must not be open!

A small example:

```
    app = ApplicationObject,
        ...,
        SubWindow, win = WindowObject,
            WindowContents, VGroup,
                ...,
                grp = VGroup,
            End,
            ...,
        End,
    End,
```

```
End;

/* The group 'grp' has been created without any children. */
/* The window must not be opened now!                     */

for (i=0; i<NumPlayers; i++)
{
   Object *name = StringObject, MUIA_String_MaxLen, 30, End;
   if (name)
      DoMethod(grp,OM_ADDMEMBER,name); // add gadget to group.
   else
      fail();
}

/* After we have at least one element in the group~'grp', */
/* the window can be opened...                            */
```

Of course you may (if the window is closed) remove elements from groups. Please note that window objects containing empty groups must not be opened.