4th Class

2024-2025

Window Programming2

برمجة النوافذ2

أ.د. يسرى حسين

Dialog Box

Although menus are an important part of nearly every Windows application, they cannot be used to handle all types of user responses. For example, it would be difficult to use a menu to input the time or date. To handle all types of input, Windows provides the ***dialog box***. A dialog box is a special type of window that provides a flexible means by which the user can interact with your application. In general, dialog boxes allow the user to select or enter information that would be difficult or impossible to enter using a menu. In this lecture, you will learn how to create and manage a dialog box.

Also discussed in this lecture are three of Windows' standard controls. Within a dialog box, interaction with the user is performed through a control. In a sense, a dialog box is simply a container that holds various control elements.

As a means of illustrating the dialog box and several controls, a very simple database application will be developed. The database contains the titles of several books along with the names of their authors, publishers, and copyright dates. The dialog box created in this lecture will allow you to select a title and obtain information about it. While the database example is, necessarily, quite simple, it will give you the flavor of how a real application can effectively use a dialog box.

Dialog Boxes Use Controls

Windows supports several standard controls, including push buttons, check boxes, radio buttons, list boxes, edit boxes, combo boxes, scroll bars, and static controls. (Windows also supports several enhanced controls called *common controls*, which are discussed later in this next lecture.) In the course of explaining how to use dialog boxes, the examples in this lecture illustrate three of these controls: the push button, the list box, and the edit box. In the next lecture, other controls will be examined.

A ***push button*** is a control that the user "pushes on" to activate some response. You have already been using push buttons in message boxes. For example, the OK button that we have been using in most message boxes is a push button. A ***list box*** displays a list of items from which the user selects one (or more). List boxes are commonly used to display things such as file names.

An ***edit box*** allows the user to enter a string. Edit boxes provide all necessary text editing features.

Therefore, to input a string, your program simply displays an edit box and waits until the user has finished typing in the string. Typically, a combo box is a combination of a list box and an edit box.

It is important to understand that controls both generate messages (when accessed by the user) and receive messages (from your application). A message generated by a control indicates what type of interaction the user has had with the control. A message sent to the control is essentially an instruction to which the control must respond.

Modal vs. Modeless Dialog Boxes

There are two types of dialog boxes: *modal* and *modeless.* The most common dialog boxes are modal. A modal dialog box demands a response from the user before the program will continue. When a modal dialog box is active, the user cannot refocus input to another part of the application without first closing the dialog box. More precisely, the *owner window* of a modal dialog box is deactivated until the dialog box is closed. (The owner window is usually the one that activates the dialog box.)

A modeless dialog box does not prevent other parts of the program from being used. That is, it does not need to be closed before input can be refocused to another part of the program. The owner window of a modeless dialog box remains active. In essence, modeless dialog boxes are more independent than modal ones.

We will examine modal dialog boxes first, since they are the most common. A modeless dialog box example concludes this lecture.

Receiving Dialog Box Messages

A dialog box is a type of window. Events that occur within it are sent to your program using the same message-passing mechanism that the main window uses. However, dialog box messages are not sent to your program's main window function. Instead, each dialog box that you define will need, its own window function, which is generally called a ***dialog function*** *or* ***dialog procedure***. This function must have this prototype. (Of course, the name of the function may be anything that you like.)

BOOL CALLBACK DFunc(HWND *Hwnd,* UINT *message,* WPARAM *wParam,*
LPARAM *lParam);*

As you can see, a dialog function receives the same parameters as your program's main window function. However, it differs from the main window function in that it returns a true or false result. Like your program's main window function, the dialog box window function will receive many messages. If it processes a message, then it must return true. If it does not respond to a message, it must return false.

In general, each control within a dialog box will be given its own resource ID. Each time that control is accessed by the user, a **WM_COMMAND** message will be sent to the dialog function, indicating the ID of the control and the type of action the user has taken. The function will then decode the message and take appropriate actions. This process parallels the way messages are decoded by your program's main window function.

Activating a Dialog Box

To activate a modal dialog box (that is, to cause it to be displayed) you must call the **DialogBox(**) API function, whose prototype is shown here:

int DialogBox(HINSTANCE *hThisInst,* LPCSTR *lpName,* HWND *hwnd,*

DLGPROC *lpDFunc);*

Here, *hThisInst* is a handle to the current

application that is passed to your program in the instance parameter to **WinMain(**). The name of the dialog box as defined in the resource file is pointed to by *lpName.* The handle to the window that owns the dialog box is passed in *hwnd.* (This is typically the handle of the window that calls **DialogBox( ).**) The *lpDFunc* parameter contains a pointer to the dialog function described in the preceding section. If **DialogBox( )** fails, it returns -1.Otherwise, the return value is that specified by **EndDialog( ) ,**discussed next.

Deactivating a Dialog Box

To deactivate (that is, destroy and remove from the screen) a modal dialog box, use **EndDialog(**). It has this prototype: BOOL EndDialog(HWND *hdwnd,* int *nStatus);*

Here, *hdwnd* is the handle to the dialog box and *nStatus* is a status code returned by the **DialogBox( )** function. (The value of *nStatus* may be ignored, if it is not relevant to your

program.) This function returns nonzero if successful and zero otherwise. (In normal situations, the function is successful.)

Creating a Simple Dialog Box

To illustrate the basic dialog box concepts, we will begin with a simple dialog box. This dialog box will contain four push buttons called Author, Publisher, Copyright, and Cancel. When either the Author, Publisher, or Copyright button is pressed, it will activate a message box indicating the choice selected. (Later these push buttons will be used to obtain information from the database. For now, the message boxes are simply placeholders.) The dialog box will be removed from the screen when the Cancel button is pressed.

The Dialog Box Resource File

A dialog box is another resource that is contained in your program's resource file. Before developing a program that uses a dialog box, you will need a resource file that specifies one. Although it is possible to specify the contents of a dialog box using a text editor and enter its specifications as you do when creating a menu, this is seldom done. Instead, most programmers use a dialog editor. The main reason for this is that dialog box definitions involve the positioning of the various controls inside the dialog box, which is best done interactively. However, since the complete .RC files for the examples in this lecture are supplied in their text form, you should simply enter them as text. Just remember that when creating your own dialog boxes, you will want to use a dialog editor.

Dialog boxes are defined within your program's resource file using the **DIALOG** statement. Its general form is shown here:

Dialog-name* DIALOG [DISCARDABLE] *X, Y, Width, Height

Features

{

Dialog-items

}

The *Dialog-name* is the name of the dialog box. The box's upper left corner will be at *X*, *Y* and the box will have the dimensions specified by *Width* and *Height.* If the box may be removed from memory when not in use, then specify it as DISCARDABLE. One or more optional

features of the dialog box may be specified. As you will see, two of these are the caption and the style of the box. The *Dialog-items* are the controls that comprise the dialog box.

The following resource file defines the dialog box that will be used by the first example program. It includes a menu that is used to activate the dialog box, the menu accelerator keys, and then the dialog box itself. You should enter it into your computer at this time, calling it DIALOG.RC.

; Sample dialog box and menu resource file.

```
#include <windows.h>
#include "dialog.h"
MyMenu MENU
{POPUP "&Dialog" {MENUITEM "&Dialog\tF2", IDM_DIALOG
                                          MENUITEM "&Exit\tF3", IDM_EXIT }
 MENUITEM "&Help", IDM_HELP }
 MyMenu ACCELERATORS
  {  VK_F2, IDM_DIALOG, VIRTKEY
     VK_F3, IDM_EXIT, VIRTKEY
     VK_F1, IDM_HELP, VIRTKEY   }
MyDB DIALOG 10, 10, 210, 110
CAPTION "Books Dialog Box"
STYLE DS_MODALFRAME | WS_POPUP | WS_CAPTION | WS_SYSMENU
{  DEFPUSHBUTTON "Author", IDD_AUTHOR, 11, 10, 36, 14,
            WS_CHILD | WS_VISIBLE | WS_TABSTOP
   PUSHBUTTON "Publisher", IDD_PUBLISHER, 11, 34, 36, 14,
            WS_CHILD | WS_VISIBLE | WS_TABSTOP
   PUSHBUTTON "Copyright", IDD_COPYRIGHT, 11, 58, 36, 14,
            WS_CHILD | WS_VISIBLE | WS_TABSTOP
   PUSHBUTTON "Cancel", IDCANCEL, 11, 82, 36, 16
            WS_CHILD | WS_VISIBLE | WS_TABSTOP   }
```

This defines a dialog box called MyDB that has its upper left corner at location 10, 10. Its width is 210 and its height is 110. The string after CAPTION becomes the title of the dialog box. The **STYLE** statement determines what type of dialog box is created. Some common style values, including those used in this lecture, are shown in Table 7-1. You can OR together the values that are appropriate for the style of dialog box that desire. These style values may also be used by other controls.

Value	Meaning
DS_MODALFRAME	Dialog box has a modal frame. This style can be used with either modal or modeless dialog boxes.
WS_BORDER	Include a border.
WS_CAPTION	Include title bar.
WS_CH1LD	Create as child window.
WS_POPUP	Create as pop-up window.
WS_MAXIMIZEBOX	Include maximize box.
WS_MINIMIZEBOX	Include minimize box.
WS_SYSMENU	Include system menu.
WSJTABSTOP	Control may be tabbed to.
WS_VISIBLE	Box is visible when activated.

Within the MyDB definition are defined four push buttons. The first is the default push button. This button is automatically highlighted when the dialog box is first displayed. The general form of a push button declaration is shown here:

PUSHBUTTON *"string", PBID, X, Y, Width, Height [, Style]*

Here, *string* is the text that will be shown inside the push button. *PDID* is the value associated with the push button. It is this value that is returned to your program when this button is pushed. The button's upper left corner will be at *X, Y* and the button will have the dimensions specified by *Width* and *Height. Style* determines the exact nature of the push button. To define a default push button use the DEFPUSHBUTTON statement. It has the same parameters as the

regular push buttons.

The header file DIALOG.H, which is also used by the example program, is shown here:

```
#define IDM_DIALOG 100
#define IDM_EXIT 101
#define IDM_HELP 102
#define IDD_AUTHOR 200
#define IDD_PUBLISHER 201
#define IDD_COPYRIGHT 202
```

Enter this file now.

The Dialog Box Window Function

As stated earlier, events that occur within a dialog box are passed to the window function associated with that dialog box and not to your program's main window function. The following dialog box window function responds to the events that occur within the **MyDB** dialog box.

```
/* A simple dialog function. */
BOOL CALLBACK DialogFunc(HWND hdwnd, UINT message, WPARAM wParam, LPARAM lParam)
{switch(message)
    { case WM_COMMAND:
        switch(LOWORD(wParam))
          {case IDCANCEL: EndDialog(hdwnd, 0); return 1;
             case IDD_COPYRIGHT: MessageBox(hdwnd, "Copyright", "Copyright", MB_OK); return 1;
          case IDD_AUTHOR: MessageBox(hdwnd, "Author", "Author", MB_OK); return 1;
          case IDD_PUBLISHER: MessageBox(hdwnd, "Publisher", "Publisher", MB_OK);return1; }
    } return 0;}
```

Each time a control within the dialog box is accessed, a **WM_COMMAND** message is sent to **DialgFunc( ), and LOWORD(wParam)** contains the ID of the control affected.

DialogFunc( ) processes the four messages that can be generated by the box. If the user

presses **Cancel,** then **IDCANCEL** is sent, causing the dialog box to be closed using a call to the API function **EndDialog( ). (IDCANCEL** is a standard ID defined by including WINDOWS.H.) Pressing either of the other three buttons causes a message box to be displayed that confirms the selection. As mentioned, these buttons will be used by later examples to display information from the database.

A First Dialog Box Sample Program

Here is the entire dialog box example. When the program begins execution, only the top-level menu is displayed on the menu bar. By selecting **Dialog,** the user causes the dialog box to be displayed. Once the dialog box is displayed, selecting a push button causes the appropriate response. A sample screen is shown in Figure 6-2. Notice that the books database is included in this program, but is not used. It will be used by subsequent examples.

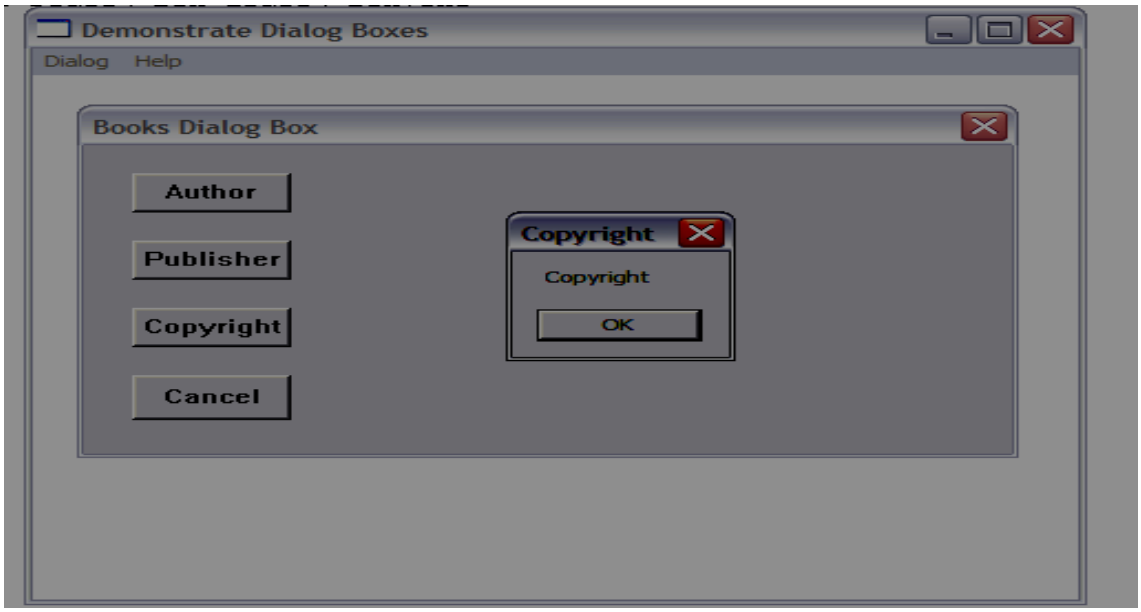
```
/* Demonstrate a modal dialog box. */
#include <windows.h>
#include <string.h>
#include <stdio.h>
#include "dialog.h"
#define NUMBOOKS 7
LRESULT CALLBACK WindowFunc(HWND, UINT, WPARAM, LPARAM);
BOOL CALLBACK DialogFunc(HWND, UINT, WPARAM, LPARAM);
char szWinName[ ] = "MyWin"; /* name of window class */  HINSTANCE hInst;
/* books database */
struct booksTag {char title[40];
                 unsigned copyright;
                  char author[40];
                char publisher[40];
               } books[NUMBOOKS] =
{{"C: The Complete Reference", 1995,"Herbert Schildt", "Osborne/McGraw-Hill"},
{"MFC Programming from the Ground Up", 1996, "Herbert Schildt", "Osborne/McGraw-Hill"},
```

```
{"Java: The Complete Reference", 1997, "Naughton and Schildt", "Osborne/McGraw-Hill"},
{"Design and Evolution of C++", 1994, "Bjarne Stroustrup", "Addison-Wesley"},
{"Inside OLE", 1995, "Kraig Brockschmidt", "Microsoft Press"},
{"HTML Sourcebook", 1996, "lan S. Graham", "John Wiley & Sons"},
{"Standard C++ Library", 1995, "P. J. Plauger", "Prentice-Hall"}};
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst, LPSTR IpszArgs, int
nWinMode) {HWND hwnd; MSG msg; WNDCLASSEX wc1; HANDLE hAccel;
wc1.cbSize = sizeof(WNDCLASSEX);wc1.hlnstance = hThisInst;
wc1.lpszClassName = szWinName; wc1.lpfnWndProc = WindowFunc; wc1.style = 0;
wc1.hIcon =   LoadIcon(NULL, IDI_APPLICATION);
wc1.hIconSm = LoadIcon(NULL, IDI_WINLOGO);
wc1.hCursor = LoadCursor(NULL, IDC_ARROW); wc1.lpszMenuName = "MyMenu";
wc1.ClsExtra=0; wc1.cbWndExtra=0; wc1.hbrBackground = GetStockObject(WHITE_BRUSH);
if(!RegisterClassEx(&wc1)) return 0;
hwnd=CreateWindow(szWinName, "Demonstrate Dialog Boxes",
wS_OVERLAPPEDWINDOW, CW_USEDEFAULT, CW_USEDEFAULT,
CW_USEDEFAULT, CW_USEDEFAULT, HWND_DESKTOP, NULL, hThisInst, NULL  );
hInst = hThisInst; /* save the current instance handle */
/* load accelerators */ hAccel = LoadAccelerators (hThisInst, "MyMenu");
/* Display the window. */ ShowWindow(hwnd, nWinMode) ; UpdateWindow(hwnd) ;
while (GetMessage(&msg, NULL, 0, 0))
{ if ( !TranslateAccelerator (hwnd, hAccel, &msg) )
{TranslateMessage(&msg) ; DispatchMes sage ( &msg ); }} return msg.wParam;  }
/* This function is called by Windows and is passedmessages from the message queue. */
 LRESULT CALLBACK WindowFunc (HWND hwnd, UINT message,
                              WPARAM wParam, LPARAM lParam) {int response;
switch (message) { case WM_COMMAND:
        switch (LOWORD (wParam) ) {
            case IDM_DIALOG: DialogBox(hInst, "MyDB" , hwnd, (DLGPROC) DialogFunc) break;
```

```
            case IDM_EXIT: response=MessageBox(hwnd,"Quit the Program?","Exit",MB_YESNO) ;
                    if (response == IDYES) PostQuitMessage (0) ; break;
             case IDM_HELP: MessageBox(hwnd, "No Help", "Help", MB_OK) ; break; } break;
      case WM_DESTROY: /* terminate the program */ PostQuitMessage (0) ; break;
      default: return DefWindowProc (hwnd, message, wParam, lParam);}     return 0; }
```

/* A simple dialog function. */ **BOOL CALLBACK DialogFunc (HWND hdwnd, UINT message, WPARAM wParam, LPARAM lParam)**

```
{ switch (message) { case WM_COMMAND:
     switch (LOWORD (wParam) ) { case IDCANCEL: EndDialog(hdwnd, 0 ) ; return 1 ;
      case IDD_COPYRIGHT: MessageBox (hdwnd, "Copyright", "Copyright", MB_OK); return 1 ;
      case IDD_AUTHOR: MessageBox (hdwnd, "Author", "Author", MB_OK) ;return 1;
      case IDD_PUBLISHER: MessageBox (hdwnd, "Publisher", "Publisher", MB_OK); return 1 ;
                  } }return 0 ;}
```



Notice the global variable **hInst.** This variable is assigned a copy of the current instance handle passed to **WinMain()**. The reason for this variable is that the dialog box needs access to the current instance handle. However, the dialog box is not created in **WinMain().** Instead, it is created in **WindowFunc( )**. Therefore, a copy of the instance parameter must be made so that it can be accessible outside of **WinMain( ).**

Adding a List Box

Dialog Box

To continue exploring dialog boxes, let's add another control to the dialog box defined in the previous program. One of the most common controls after the push button is the list box. We will use the list box to display a list of the titles in the database and allow the user to select the one in which he or she is interested. The **L1STBOX** statement has this general form: **LISTBOX *LBID, X, Y, Width, Height [, Style]***

Here, *LBID* is the value that identifies the list box. The box's upper left corner will be at *X, Y* and the box will have the dimensions specified by *Width* and *Height. Style* determines the exact nature of the list box. To add a list box, you must change the dialog box definition in DIALOG.RC. First, add this list box description to the dialog box definition:

LISTBOX IDD_LB1, 60, 5, 140, 33, LBS_NOTIFY | WS_VISIBLE

| WS_BORDER | WS_VSCROLL | WS_TABSTOP

Second, add this push button to the dialog box definition:

PUSHBUTTON "Select Book", IDD_SELECT, 103, 41, 54, 14, WS_CHILD

| WS_VISIBLE | WS_TABSTOP

After these changes, your dialog box definition should now look like this:

MyDB DIALOG 10, 10, 210, 110 CAPTION "Books Dialog Box" STYLE
DS_MODALFRAME | WS_POPUP |WS_CAPTION | WS_SYSMENU
DEFPUSHBUTTON "Author", IDD_AUTHOR, 11, 10, 36, 14
WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Publisher", IDD_PUBLISHER, 11, 34, 36, 14,
WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Copyright" , IDD_COPYRIGHT, 11, 58, 36, 14,
WS_CHILD| WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Cancel", IDCANCEL, 11, 82, 36, 16,
WS_CHILD| WS_VISIBLE | WS_TABSTOP
LISTBOX IDD_LB1, 60, 5, 140, 33, LBS_NOTIFY | WS_VISIBLE |WS_VSCROLL |
WS_BORDER |WS_TABSTOP
PUSHBUTTON "Select Book", IDD_SELECT, 103, 41, 54, 14,
WS_CHILD | WS_VISIBLE | WS_TABSTOP}

You will also need to add these macros to DIALOG. H:

```
#define IDD_LB1      203
#define IDD_SELECT   204
```

IDD_LB1 identifies the list box specified in the dialog box definition in the resource file. **IDD_SELECT** is the ID value of the Select Book push button.

List Box Basics

When using a list box, you must perform two basic-operations. First, you must initialize the list box when the dialog box is first displayed. This consists of sending the list box the list that it will display. (By default, the list box will be empty.) Second, once the list box has been initialized, your program will need to respond to the user selecting an item from the list. List boxes generate various types *of notification messages.* A notification message describes what type of control event has occurred. (Several of the standard controls generate notification messages.) For the list box used in the following example, the only notification message we will use is **LBN_DBLCLK**. This message is sent when the user has double-clicked on an entry in the list. This message is contained in **HIWORD(wParam)** each time a **WM_COMMAND** is generated for the list box. (The list box must have the **LBS_NOTIFY** style flag included in its definition in order to generate **LBN_DBLCLK** messages.) Once a selection has been made, you will need to query the list box to find out which item has been selected, A list box is a control that receives messages as well as generating them. You can send a list box several different messages. To send a message to the list box (or any other control) use the **SendDlgItemMessage( )** API function. Its prototype is shown here:

LONG SendDlgItcmMessage(HWND *Hwnd,* int *ID,* UINT *IDMsg,* WPARAM *wParam,* LPARAM *lParam);

SendDlgItemMessage() sends the message specified by *IDMsg* to the control (within the dialog box) whose ID is specified by *ID.* The handle of the dialog box is specified in *hdwnd.* Any additional information required f the message is specified in *wParam* and *lParam.* The additional informal, if any, varies from message to message. If there is no additional information to pass to a control, the *wParam* and the *lParam* arguments should be zero. The value returned by **SendDlgItemMessage( )** contains the information requested by *IDMsg.*

Macro	Purpose
LB_ADDSTRING	Adds a string (selection) to the list box.

LB_GETCURSEL	Requests the index of the selected item.
LB_SETCURSEL	Selects an item.
LBJ-'FINDSTRING	Finds a matching entry.
LB_SELECTSTR1NG	Finds a matching entry and selects It.
LB_GE'ITEXT	Obtains the text associated with an Item

Here are a few of the most common messages that you can send to a list box. Let's take a closer look at these messages.

LB_ADDSTRING adds a string to the list box. That is, the specified string becomes another selection within the box. The string must be pointed to by *lParam. (wParam* is unused by this message.) The value returned by list box is the index of the string in the list. If an error occurs, **LB_ERR** is returned.

The **LB_GETCURSEL** message causes the list box to return the index of the currently selected item. All list box indexes begin with zero. Both *lParam* and *wParam* are unused. If an error occurs, **LB_ERR** is returned. If no item is currently selected, then an error results.

You can set the current selection inside a list box using the **LB_SETCURSEL** command. For this message, *wParam* specifies the index of the item to select. *lParam* is not used. On error, **LB_ERR** is returned.

You can find an item in the list that matches a specified prefix using **LB_FINDSTRING.** That is, **LB_FINDSTRING** attempts to match a partial string with an entry in the list box. *wParam* specifies the index at which point the search begins and *lParam* points to the string that will be matched. If a match is found, the index of the matching item is returned. Otherwise, **LB_ERR** is returned. **LB_FINDSTRING** does not select the item within the list box.

If you want to find a matching item and select it, use **LB_SELECTSTRING.** It takes the same parameters as **LB_FINDSTRING** but also selects the matching item.

You can obtain the text associated with an item in a list box using **LB_GETTEXT.** In this

case, *wParam* specifies the index of the item and *lParam* points to the character array that will receive the null terminated string associated with that index. The length of the string is returned if successful. **LB_ERR** is returned on failure.

Initializing the List Box

As mentioned, when a list box is created, it is empty. This means that you will need to initialize it each time the dialog box that contains it is displayed. This is easy to accomplish because each time a dialog box is activated, its window function is sent a **WM_INITDIALOG** message. Therefore, you will need to add this case to the outer **switch** statement in **DialogFunc( ).**

```
case WM_INITDIALOG: /* initialize list box */
  for(i=0; i<NUMBOOKS; i + +)
  SendDlgItemMessage(hdwnd, IDD_LB1,LB_ADDSTRING, 0, (LPARAM)books[i].title);
  /*select first item*/ SendDlgItemMessage(hdwnd, IDD_LB1,LB_SETCURSEL, 0, 0); return 1;
```

This code loads the list box with the titles of books as defined in the **books** array. Each string is added to the list box by calling **SendDlgItemMessage( )** with the **LB_ADDSTRING** message. The string to add is pointed to by the *lParam* parameter. (The type cast to **LPARAM** is necessary in this case to convert a pointer into a unsigned integer.) In this example, each string is added to the list box in the order it is sent. (However, depending on how you construct the list box, it is possible to have the items displayed in alphabetical order.) If the number of items you send to a list box exceeds what it can display in its window, vertical scroll bars will be added automatically.

This code also selects the first item in the list box. When a list box is first created, no item is selected. While this might be desirable under certain circumstances, it is not in this case. Most often, you will want to automatically select the first item in a list box as a convenience to the user.

Processing a Selection

After the list box has been initialized, it is ready for use. There are essentially two ways a user makes a selection from a list box. First, the user may double-click on an item. This causes a **WM_COMMAND** message to be passed to the dialog box's window function. In

this case, **LOWORD(wParam)** contains the ID associated with the list box and **HIWORD(wParam)** contains the **LBN_DBLCLK** notification message. Double-clicking causes your program to be immediately aware of the user's selection. The other way to use a list box is to simply highlight a selection (either by single-clicking or by using the array keys to move the highlight). The list box remembers the selection and waits until your program requests it. Both methods will be demonstrated in the example program.

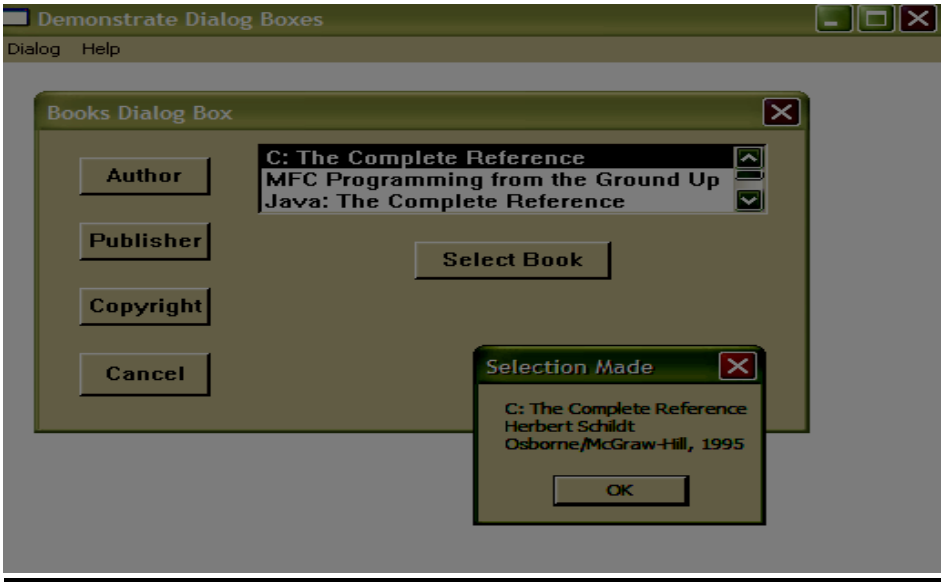
Once an item has been selected in a list box, you determine which item was chosen by sending the **LB_GETCURSEL** message to the list box. The list box then returns the index of the selected item. Remember, if this message is sent before an item has been selected, the list box returns **LB_ERR.** (This is one reason that it is a good idea to select a list box item when it is initialized.)

To process a list box selection, add these cases to the inner switch inside DialogFunc( ). You will also need to declare a long integer called i and a character array called str inside DialogFunc( ). Your dialog box will now look like that shown in Figure 7-3. Each time a selection is made because of a double-click or when the user presses the "Select Book" push button, the currently selected book has its information displayed.

```
case IDD_LB1: /* process a list box LBN_DBLCLK */
 /* see if user made a selection */
   if(HIWORD(wParam)==LBN_DBLCLK)
    { i = SendDlgItemMessage(hdwnd, IDD_LBl, LB_GETCURSEL, 0, 0);  /* get index */
      sprintftstr, "%s\n%s\n%s, %u", books[i] .title, books[i].author, books[i].publisher,
books[i].copyright);
      MessageBox(hdwnd, str, "Selection Made", MB_OK);
     /* get string associated with that index */
    SendDlgItemMessage(hdwnd, IDD_LB1, LB_GETTEXT, i, (LPARAM) str); } return 1;
case IDD_SELECT: /* Select Book button has been pressed */
  i=SendDlgItemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0);  /* get index */
 sprintf(str, "%s\n%s\n%s, %u", books[i].title, books[i].author, books[i].publisher,
   books[i].copyright);
 MessageBox(hdwnd, str, "Selection Made", MB_OK);
```

```
/* get string associated with that index */
SendDlgItemMessage (hdwnd, IDD_LB1, LB_GETTEXT, i, (LPARAM) str); return 1;
```

Notice the code under the **IDD_LB1** case. Since the list box can generate several different types of notification messages, it is necessary to examine the high-order word of **wParam** to determine if the user double-clicked on an item. That is, just because the control generates a notification message does not mean it is a double-click message. (You will want to explore the other list box notification messages on your own.)



Adding an Edit Box

In this section we will add an edit control to the dialog box. Edit boxes are particularly useful because they allow users to enter a string of their own choosing. The edit box in this example will be used to allow the user to enter the title (or part of a title) of a book. If the title is in the list, then it will t selected and information about the book can be obtained. Although the addition of an edit box enhances our simple database application, it also serves another purpose. It will illustrate how two controls can work together.

Before you can use an edit box, you must define one in your resource file for this example, change **MyDB** so that it looks like this:

```
MyDB DIALOG 10, 10, 210, 110
CAPTION "Books Dialog Box"
STYLE DS_MODALFRAME | WS_POPUP |WS_CAPTION | WS_SYSMENU
{DEFPUSHBUTTON "Author", IDD_AUTHOR, 11, 10, 36, 14
    WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Publisher", IDD_PUBLISHER, 11, 34, 36, 14
    WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Copyright", IDD_COPYRIGHT, 11, 58, 36, 14
    WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Cancel", IDCANCEL, 11, 82, 36, 16,
    WS_CHILD | WS_VISIBLE | WS_TABSTOP
LISTBOX IDD_LB1, 60, 5, 140, 33, LBS_NOTIFY | WS_VISIBLE|
    WS_BORDER |WS_VSCROLL | WS_TABSTOP
PUSHBUTTON "Select Book", IDD_SELECT, 103, 41, 54, 14,
    WS_CHILD | WS_VISIBLE | WS_TABSTOP
EDITTEXT IDD_EB1, 65, 73, 130, 12, ES_LEFT | WS_VISIBLE WS_BORDER |
    ES_AUTOHSCROLL | WS_TAB5TOP
PUSHBUTTON "Title Search", IDD_DONE, 107, 91, 46, 14, WS_CHILD |
    WS_VISIBLE | WS_TABSTOP}
```

This version adds a push button called Title Search which will be used to tell the program that you entered the title of a book into the edit box. It also adds the edit box itself. The ID for the edit box is **IDD_EB1.** This definition causes a standard edit box to be created.

The **EDITTEXT** statement has this general form: EDITTEXT *EDID, X, Y, Width, Height [.Style]*

Here, *EDID* is the value that identifies the edit box. The box's upper left corner will be at X, *Y* and its dimensions are specified by *Width* and *Height. Style* determines the exact nature of the list box. You must also add these macro definitions to DIALOG.H:

```
#define IDD_EB1 205
#define IDD_DONE 206
```

Edit boxes recognize many messages and generate several of their own. However, for the purposes of this example, there is no need for the program to respond to any messages. As you

will see, edit boxes perform the editing function on their own, independently. No program interaction is required. Your program simply decides when it wants to obtain the current contents of the edit box.

To obtain the current contents of the edit box, use the API function **GetDlgItemText( ).** It has this prototype: **UINT GetDlgItemText(HWND *hdwnd*, int *ID*, LPSTR *lpstr*, int *Max);**

This function causes the edit box to copy the current contents of the box to the string pointed to by *lpstr*. The handle of the dialog box is specified by *hdwnd*. The ID of the edit box is specified by *ID*. The maximum number of characters to copy is specified by *Max*. The function returns the length of the string..

Although not required by all applications, it is possible to initialize the contents of an edit box using the **SetDlgItemText( )** function. Its prototype is shown here:

BOOL SetDlgItemText(HWND *hdwnd*, int *ID*, LPSTR *lpstr);

This function sets the contents of the edit box to the string pointed to by *lpstr*. The handle of the dialog box is specified by *hdwnd*. The ID of the edit box is specified by *ID*. The function returns nonzero if successful or zero on failure.

To add an edit box to the sample program, add this case statement to the inner **switch** of the **DialogFunc( )** function. Each time the Title Search button is pressed, the list box is searched for a title that matches the string that is currently in the edit box. If a match is found, then that title is selected in the list box. Remember that you only need to enter the first few characters of the title. The list box will automatically attempt to match them with a title.

```
case IDD_DONE: /* Title Search button pressed */
 /* get current contents of edit box */ GetDlgItemText (hdwnd, IDD_EB1, str, 80);
/* find a matching string in the list box */
i = SendDlgItemMessage( hdwnd, IDD_LB1, LB_FINDSTRING, 0, (LPARAM) str) ;
if(i != LB_ERR) { /* if match is found */
 /*select the matching title in list box*/
 SendDlgItemMessage(hdwnd, IDD_LB1, LB_SETCURSEL, i, 0);
```

```
/* get string associated with that index */
SendDlgItemMessage(hdwnd, IDD_LB1, LB_GETTEXT, i, (LPARAM) str);
/* update text in edit box */ SetDlgItemText (hdwnd, IDD_EB1, str) ;
else MessageBox (hdwnd, str, "No Title Matching", MB_OK) ; return 1 ;
```

This code obtains the current contents of the edit box and looks for a match with the strings inside the list box. If it finds one, it selects the matching item in the list box and then copies the string from the list box back into the edit box. In this way, the two controls work together, complementing each other. As you become a more experienced Windows programmer, you will find that there are often instances in which two or more controls can work together.

You will also need to add this line of code to the **INITDIALOG** case. It causes the edit box to be initialized each time the dialog box is activated.

```
/* initialize the edit box */   SetDlgItemText(hdwnd, IDD_EB1, books[0].title);
```

In addition to these changes, the code that processes the list box will be enhanced so that it automatically copies the name of the book selected in the list box into the edit box. These changes are reflected in the full program listing that follows. You should have no trouble understanding them.

The Entire Modal Dialog Box Program

The entire modal dialog box sample program that includes push buttons, a list box, and an edit box, is shown here. Notice that the code associated with the push buttons now displays information about the title currently selected in the list box.

```
/*  A Complete model dialog box example. */


#include <windows.h>
#include <string.h>
#include <stdio.h>
#include "dialog.h"
#define NUMBOOKS 7
LRESULT CALLBACK WindowFunc(HWND, UINT, WPARAM, LPARAM);
```

Dialog Box

```
BOOL CALLBACK DialogFunc(HWND, UINT, WPARAM, LPARAM);
char szWinName[ ] = "MyWin"; /* name of window class */
HINSTANCE hInst;
/* books database */ struct booksTag {char title[40];
                                    unsigned copyright;
                                    char author[40];
                                    char publisher[40]; } books[NUMBOOKS] =
{{"C: The Complete Reference", 1995,"Herbert Schildt", "Osborne/McGraw-Hill"},
{"MFC Programming from the Ground Up", 1996, "Herbert Schildt", "Osborne/McGraw-Hill"},
{"Java: The Complete Reference", 1997, "Naughton and Schildt", "Osborne/McGraw-Hill"},
{"Design and Evolution of C++", 1994, "Bjarne Stroustrup", "Addison-Wesley"},
{"Inside OLE", 1995, "Kraig Brockschmidt", "Microsoft Press"},
{"HTML Sourcebook", 1996, "lan S. Graham", "John Wiley & Sons"},
{"Standard C++ Library", 1995, "P. J. Plauger", "Prentice-Hall"}};
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst, LPSTR IpszArgs, int
nWinMode) {HWND hwnd; MSG msg; WNDCLASSEX wc1; HANDLE  hAccel;
wc1.cbSize = sizeof(WNDCLASSEX);wc1.hInstance = hThisInst;
wc1.lpszClassName = szWinName; wc1.lpfnWndProc = WindowFunc; wc1.style = 0;
wc1.hIcon =   LoadIcon(NULL, IDI_APPLICATION);
wc1.hIconSm = LoadIcon(NULL, IDI_WINLOGO);
wc1.hCursor   = LoadCursor(NULL, IDC_ARROW); wc1.lpszMenuName = "MyMenu";
wc1.ClsExtra=0;wc1.cbWndExtra=0;wc1.hbrBackground = GetStockObject(WHITE_BRUSH);
/* Register the window class. */ if(!RegisterClassEx(&wc1)) return 0;
/* Now that a window class has been registered, a window can be created. */
hwnd = CreateWindow(szWinName, "Demonstrate Dialog Boxes",
WS_OVERLAPPEDWINDOW, CW_USEDEFAULT, CW_USEDEFAULT,
CW_USEDEFAULT, CW_USEDEFAULT, HWND_DESKTOP, NULL, hThisInst, NULL  );
hInst = hThisInst; /* save the current instance handle */
```

Dialog Box

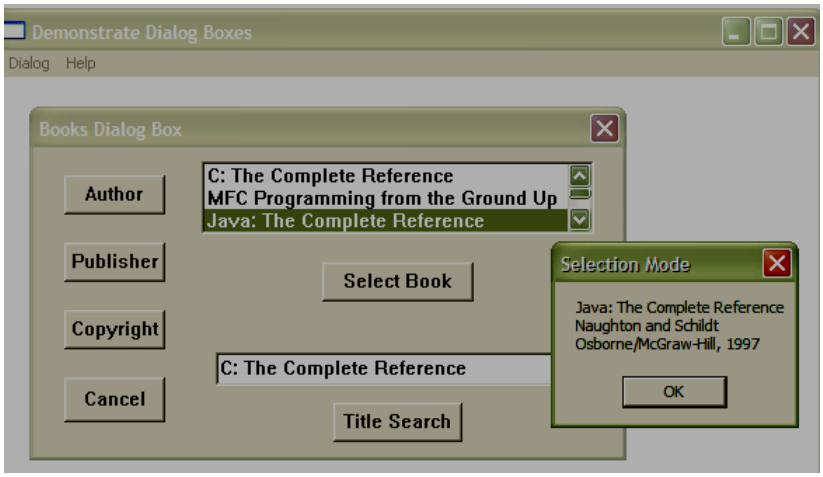
```
/* load accelerators */ hAccel = LoadAccelerators (hThisInst, "MyMenu");
/* Display the window. */ ShowWindow(hwnd, nWinMode) ; UpdateWindow(hwnd) ;
while (GetMessage(&msg, NULL, 0, 0))
{ if ( !TranslateAccelerator (hwnd, hAccel, &msg) ) {TranslateMessage(&msg) ;
                                                    DispatchMes sage ( &msg ); }} return msg.wParam ;}
/* This function is called by Windows and is passed messages from the message queue. */
 LRESULT CALLBACK WindowFunc (HWND hwnd, UINT message,
                                                WPARAM wParam, LPARAM lParam) { int response;
switch (message)
{case WM_COMMAND:
      swi tch ( LOWORD { wParam) )
         {case IDM_DIALOG: DialogBox (hlnst, "MyDB", hwnd, (DLGPROC) DialogFunc) break;
           case IDM_EXIT: response=MessageBox (hwnd,"Quit the Program?","Exit", MB_YESNO) ;
                                                if (response == IDYES) PostQuitMessage (0) ; break;
           case I DM HELP: MessageBox(hwnd, "No Help", "Help", MB_OK); break;} break;
case WM_DESTROY: /* terminate the program */ PostQuitMessage(0); break;
default :return DefWindowProc(hwnd, message, wParam, lParam); } return 0;}
BOOL CALLBACK DialogFunc(HWND hdwnd, UINT message, WPARAM wParam,
LPARAM lParam){ long i; char str[255];
switch(message) { case WM_COMMAND:
                        switch(LOWORD(wParam)){
                          case ID_CANCEL: EndDialog(hdwnd, 0); return 1;
                                  case IDD_COPYRIGHT:
                i = SendDlgItemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0); /* get index */
                sprintf(str, "%u", books [ i ] .copyright) ,;
                  MessageBox(hdwnd, str, "Copyright", MB_OK); return 1;
                        case IDD_AUTHOR:
                i = SendDlgItemMessage(hdwnd, IDD_LB1,LB_GETCURSEL, 0, 0);  /*get index*/
                 sprintf(str, "%s", books[i].author);
                 MessageBox(hdwnd, str, "Author", MB_OK); return 1;
```

```
                                    case IDD_PUBLISHER:
                i = SendDlgItemMessage(hdwnd, IDD_LB1,LB_GETCURSEL, 0, 0);  /*get index*/
                sprintf(str, "%s", books[i].publisher);
                 MessageBox(hdwnd, str, "Publisher", MB_OK); return 1;
                            case IDD_DONE: /* Title Search button pressed */
               /* get current contents of edit box */ GetDlgItemText(hdwnd, IDD_EB1, str, 80);
                 /*find a matching string in the list box*/
                i=SendDlgItemMessage(hdwnd,IDD_LB1,LB_FINDSTRING,0,(LPARAM) str);
                                if(i != LB_ERR) { /* if match is found */
                                  /*select the matching title in list box*/
        SendDlgItemMessage(hdwnd, IDD_LB1, LB_SETCURSEL, i, 0)
        /* get string associated with that index */
         SendDlgItemMessage(hdwnd, IDD_LB1,LB_GETTEXT, i, (LPARAM) str);
         /* update edit box */ SetDlgItemText(hdwnd, IDD_EB1, str); }
        else MessageBox(hdwnd, str, "No Title Matching", MB_OK);  return 1;
case IDD_LB1: /* process a list box LBN_DBLCLK */
  /* see  if user made a selection */
 if(HIWORD(wParam)==LBN_DBLCLK) {
     i= SendDlgItemMessage (hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0); /* get index */
     sprintf(str, "%s\n%s\n%s, %u", books[i].title, books[i].author, books[i].publisher,
     books[i].copyright);
     MessageBox(hdwnd, str, "Selection Mode", MB_OK);
    /*get string associated with that index*/
     SendDlgItemMessage(hdwnd, IDD_LB1,LB_GETTEXT, i, (LPARAM) str);
  /* update edit box */ SetDlgItemText(hdwnd, IDD_EB1, str); } return 1;


case IDD_SELECT: /* Select book button has been pressed */
     i= SendDlgItemMessage (hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0); /* get index */
     sprintf(str, "%s\n%s\n%s, %u", books[i].title, books[i].author, books[i].publisher,
```

```
books[i].copyright); MessageBox(hdwnd, str, "Selection Mode", MB_OK);
/* get string associated with that index */
SendDlgItemMessage(hdwnd, IDD_LB1,LB_GETTEXT, i, (LPARAM) str);
/* update edit box */ SetDlgItemText(hdwnd, IDD_EB1, str); } return 1;} break;
case WM_INITDIALOG: /* initialize list box */
for ( i =0; i<NUMBOOKS; i + + )
SendDlgItemMessage(hdwnd, IDD_LB1, LB_ADDSTRING, 0, (LPARAM)books[i].title);
/* select first item */ SendDlgItemMessage(hdwnd, IDD_LB1, LB_SETCURSEL, 0, 0);
/* initialize the edit box */ SetDlgItemText(hdwnd, IDD_EB1, books[0].title);
return 1;} return 0;}
```

Figure 6-2 shows sample output created by the complete modal dialog box program.



Using a Modeless Dialog Box

To conclude this lecture, the modal dialog box used by the preceding program will be converted into a modeless dialog box. As you will see, using a modeless dialog box requires a little more work. The main reason for this is that a modeless dialog box is more independent than a modal dialog box. Specifically, the rest of your program is still active when a modeless dialog box is displayed. Also, both it and your application's window function continue to receive messages. Thus, some additional overhead is required in your application's message loop to accommodate the modeless dialog box.

To create a modeless dialog box, you do not use **DialogBox()**. Instead, you must use the **CreateDialog( )** API function. Its prototype is shown here:

HWND CreateDialog(HINSTANCE *hTlnsInst*, LPCSTR *lpName*, HWND *hwnd*,

DLGPROC *lp.DFunc);*

Here, *hThisInst* is a handle to the current application that is passed to your program in the instance parameter to **WinMain().** The name of the dialog box as defined in the resource file is pointed to by *lpName.* The handle to the owner of the dialog box is passed in *hwnd.* (This is typically the handle to the window that calls **CreateDialog()**.) The *lpDFunc* parameter contains a pointer to the dialog function. The dialog function is of the same type as that used for a modal dialog box. **CreateDialog()** returns a handle to the dialog box. If the dialog box cannot be created, **NULL** is returned.

Unlike a modal dialog box, a modeless dialog box is not automatically visible, so you may need to call **ShowWindow()** to cause it to be displayed after it has been created. However, if you add **WS_VISIBLE** to the dialog box's definition in its resource file, then it will be visible automatically.

To close a modeless dialog box your program must call **DestroyWindow()** rather than **EndDialog( ).** The prototype for **DestroyWindow()** is shown here:

BOOL DestroyWindow(HWND *hwnd);*

Here, *hwnd* is the handle to the window (in this case, dialog box) being closed. The function returns nonzero if successful and zero on failure.

Since your application's window function will continue receiving messages while a modeless dialog box is active, you must make a change to your program's message loop. Specifically, you must add a call to **IsDialogMessage( ).** This function routes dialog box messages to your modeless dialog box. It has this prototype:

BOOL IsDialogMessage(HWND *hdwnd*, LPMSG *msg*)

IN DEPTH: Disabling a Control: Sometimes you will have a control that is not applicable to all situations. When a control is not applicable it can be (and should be) disabled. A control that is disabled is displayed in gray and may not be selected. To disable a control, use the **EnableWindow( )** API function, shown here:

BOOL EnableWindow(HWND *hCntl*, BOOL How);

Here, *hCntl* specifies the handle of the window to be affected. (Remember, controls are simply

specialized windows.) If How is nonzero, then the control is enabled. That is, it is activated. If *How* is zero, the control is disabled. The function returns nonzero if the control was already disabled. It returns zero if the control was previously enabled. To obtain the handle of a control, use the **GetDlgItem(**) API function. It is shown here:

HWND GetDlgItem(HWND *hDwnd*, int *ID);*

Here, *hDwnd* is the handle of the dialog box that owns the control. The control ID is passed in *ID*. This is the value that you associate with the control in its resource file. The function returns the handle of the specified control or **NULL** on failure.

To see how you can use these functions to disable a control, the following fragment disables the Author push button. In this example **hwpb** is a handle of type **HWND.**

```
hwpb = GetDlgItem(hdwnd, IDD_AUTHOR); /*get handle of button */
EnableWindow(hwpb, 0); /* disable it*/
```

On your own, you might want to try disabling and enabling the other controls used by the examples in this and later lectures.

Here, *hdwnd* is the handle of the modeless dialog box and *msg* is the message obtained from **GetMessage()** within your program's message loop. The function returns nonzero if the message is for the dialog box. It returns zero otherwise. If the message is for the dialog box, then it is automatically passed to the dialog box function. Therefore, to process modeless dialog box messages, your program's message loop must look something like this:

```
while (GetMessage(&msg, NULL, 0, 0)){
 if ( ! IsDialogMessage (hDlg, &msg) ){ /*not dialog box message*/
    if ( !TranslateAccelerator (hwnd, hAccel, &msg)) {
        TranslateMessage (&msg) ; /* translate keyboard message */
        DispatchMessage(&msg) ; /* return control to Windows */ }}}
```

As you can see, the message is processed by the rest of the message loop only if it is not a dialog box message.

Creating a Modeless Dialog Box

To convert the modal dialog box shown in the preceding example into a modeless one, surprisingly few changes are needed. The first change that you need to make is to the dialog

box definition in the DIALOG. RC resource file. Since a modeless dialog box is not automatically visible, add **WS_VISIBLE** to the dialog box definition. Also, although not technically necessary, you can remove the **DS_MODALFRAME** style, if you like. Since we have made several changes to DIALOG. RC since the start of the chapter, its final form is shown here after making these adjustments.

```
; Sample dialog box and menu resource file.
#include <windows.h>
#include "dialog. h"
MyMenu MENU {
   POPUP "&Dialog {MENUITEM "&Dialog\tF2", IDM_DIALOG
                          MENUITEM &Exit\tF3", IDM_EXIT}
  MENUITEM "&Help", IDM_HELP
  MyMenu ACCELERATORS
        {VK_F2, IDM_DIALOG, VIRTKEY
         VK_F3, IDM_EXIT, VIRTKEY
         VK_F1, IDM_HELP, VIRTKEY}
MyDB DIALOG 10, 10, 210, 110 CAPTION  "Books Dialog Box"
STYLE WS_POPUP | WS_CAPTION |WS_SYSMENU | WS_VISIBLE
{DEFPUSHBUTTON "Author", IDD_AUTHOR, 11, 10, 36, 14
            WS_CHILD | WS_VISIBLE | WS_TABSTOP
 PUSHBUTTON "Publisher", IDD_PUBLISHER, 11, 34, 36, 14,
            WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Copyright", IDD_COPYRIGHT, 11, 58, 36, 14,
           WS_CHILD | WS_VISIBLE | WS_TABSTOP
PUSHBUTTON "Cancel", IDCANCEL, 11, 82, 36, 16,
           WS_CHILD |WS_VISIBLE | WS_TABSTOP
LISTBOX IDD_LB1, 60, 5, 140, 33, LBS_NOTIFY | WS BORDER |WS_VISIBLE |
           WS_VSCROLL | WS_TABSTOP
PUSHBUTTON "Select Book", IDD_SELECT, 103, 41, 54, 14,
            WS_CHILD | WS_VISIBLE | WS_TABSTOP
```

EDITTEXT IDD_EB1, 65, 73, 130, 12, ES_LEFT | WS_VISIBLE |WS_BORDER |
ES_AUTOHSCROLL | WS_TABSTOP
PUSHBUTTON "Title Search", IDD_DONE, 107, 91, 46, 14,
WS CHILD |I WS_VISIBLE | WS_TABSTOP }

Next, you must make the following changes to the program:

1. Create a global handle called **hDlg.**
2. Add **IsDiaLogMessage( )** to the message loop.
3. Create the dialog box using **CreateDialog()** rather than **DialogBox().**
4. Close the dialog box using **DestroyWindow( )** instead of **EndDialog().**

The entire listing (which incorporates these changes) for the modeless dialog box example is shown here. Sample output from this program is shown in Figure 7-4. (You should try this program on your own to fully understand the difference between modal and modeless dialog boxes.)

```
/* A modeless dialog box example. */
#include <windows.h>
#include <string.h>
#include <stdio.h>
#include "dialog.h"
#define NUKBOOKS 7
LRESULT CALLBACK WindowFunc (HWND, UINT, WPARAM, LPARAM) ;
BOOL CALLBACK DialogFunc (HWND, UINT, WPARAM, LPARAM) ;
char szWinName [ ] = "MyWin" ; /* name of window class */ H INSTANCE hInst;
HWND hDlg = 0 ;  /* dialog box handle */
/* books database */
struct booksTag { char title [40] ;
                  unsigned copyright;
                 char author[40];
                char publisher [40] ; }
books[NUMBOOKS] = {
  {"C: The Complete Reference", 1995,"Hebert Schildt", "Osborne/McGraw-Hill"},
```

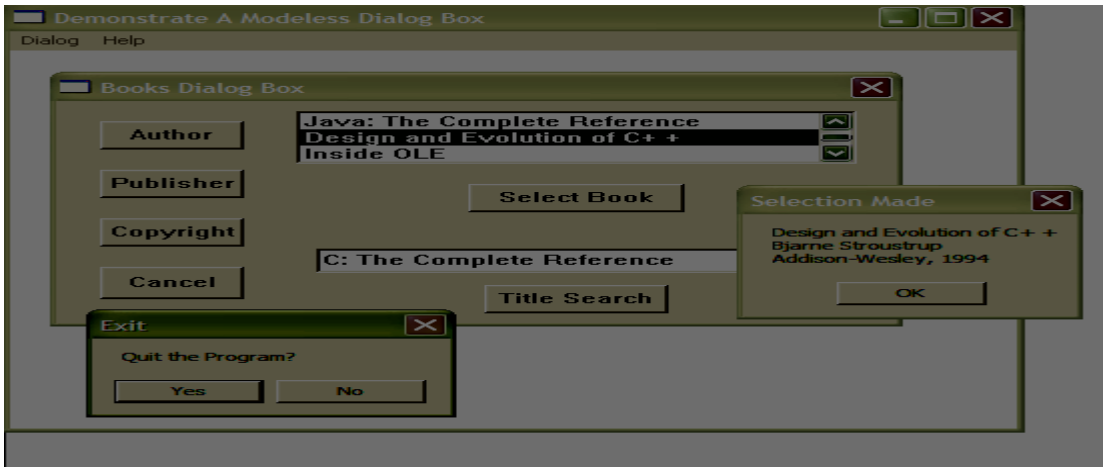
```
  { "MFC Programming from the Ground Up", 1996, "Herbert Schildt",
  "Osborne/McGraw-Hill" },
{"Java:The Complete Reference",1997,"Naughton and Schildt","Osborne/McGraw-Hill " },
  {"Design and Evolution of C+ + ", 1994", "Bjarne Stroustrup" , "Addison-Wesley" },
  { Inside OLE" , 1995, "Kraig Brockschmidt" , "Microsoft Press" },
  {"HTML Sourcebook", 1996, "lan S. Graham", "John Wiley & Sons" },
  {"Standard C++ Library", 1995, "P. J. Plauger", "Prentice-Hall" } };
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst,
                                        LPSTR IpszArgs, int nWinMode)
{HWND hwnd; MSG msg; WNDCLASSEX wcl; HANDLE hAccel;
wc1.cbSize = sizeof(WNDCLASSEX);wc1.hInstance = hThisInst;
wc1.lpszClassName = szWinName; wc1.lpfnWndProc = WindowFunc;
wc1.style =0; wc1.hIcon =      LoadIcon(NULL, IDI_APPLICATION);
wc1.hIconSm= LoadIcon(NULL, IDI_WINLOGO);
wc1.hCursor= LoadCursor(NULL, IDC_ARROW);lpszMenuName = "MyMenu";
wc1.cbClsExtra = 0; wc1.cbWndExtra = 0;
wc1.hbrBackground = (HBRUSH) GetStockObject(WHITE_BRUSH);
/* Register the window class. */ if(!RegisterClassEx(&wc1)) return 0;
/* Now that a window class has been registered, a window can be created. */
hwnd=CreateWindow(szWinName,"Demonstrate A Modeless Dialog Box",
WS_OVERLAPPEDWINDOW,CW_USEDEFAULT,CW_USEDEFAULT,
CW_USEDEFAULT,CW_USEDEFAULT,HWND_DESKTOP,
NULL, hThisInst,  NULL);   hInst = hThisInst; /* save the current instance handle */
 /* load accelerators */ hAccel = LoadAccelerators (hThisInst, "MyMenu");
/* Display the window. */ ShowWindiow(hwnd, nWinMode) ; UpdateWindow(hwnd) ;
 while (GetMessage(&msg, NULL, 0, 0))
  {if ( ! IsDialogMessage (hDlg, &msg) )
    {/* is not a dialog message*/ if ( !TranslateAccelerator (hwnd, hAccel, &msg) )
```

```
    {TranslateMessage(&msg); DispatchMessage(&.msg);  } return msg.wParam; }

/* This function is called by Windows NT and is passed messages from the message queue. */
 LRESULT CALLBACK WindowFunc(HWND hwnd, UINT message,
                                        WPARAM wParam, LPARAM lParam) { int response;
switch(message) { case WM_COMMAND:
  switch(LOWORD(wParam))
  {case IDM_DIALOG: hDlg = CreateDialog(hlnst, "MyDB", hwnd, (DLGPROC)
DialogFunc);break;
   case IDM_EXIT: response = MessageBox(hwnd, "Quit the Program?", "Exit", MB_YESNO);
                        if(response == IDYES) PostQuitMessage(0); break;
   case IDM_HELP: MessageBox(hwnd, "No Help", "Help", MB__OK) ; break; } break;
   case WM_DESTROY: /* terminate the program */ PostQuitMessage(0); break;
  default: return DefWindowProc(hwnd, message, wParam, IParam); } return 0;}
/* A simple dialog function. */
BOOL CALLBACK DialogFunc(HWND hdwnd, UINT message, WPARAM wParam,
LPARAM lParam) { long i; char str[255];
switch(message)
{case WM_COMMAND:
    switch(LOWORD(wParam))
    {case IDCANCEL: DestroyWindow(hdwnd); return 1;
      case IDD_COPYRIGHT:
          i = SendDlgltemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0);
         sprintf(str,"%u", books[i].copyright);
        MessageBox(hdwnd, str, "Copyright", MB_OK); return 1;
     case IDD_AUTHOR: i = SendDlgltemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0);
                        sprintf(str, "%s", books[i].author);
                        MessageBox(hdwnd, str, "Author", MB_OK); return 1;
  case IDD_PUBLISHER: i=SendDlgltemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0);
                        sprintftstr, "%s", books[i].publisher);
```

```
                    MessageBox(hdwnd, str, "Publisher", MB_OK); return 1;
case IDD_DONE:/*get current contents of edit box*/ GetDlgItemText(hdwnd, IDD_EB1, str, 80);
        i=SendDlgItemMessage(hdwnd, IDD_LB1, LB_FINDSTRING, 0, (LPARAM) str);
        if(i != LB_ERR) /* if match is found */
                {SendDlgItemMessage(hdwnd,IDD_LB1, LB_SETCURSEL, i,0);
                SendDlgItemMessage(hdwnd,IDD_LB1,LB_GETTEXT, i, (LPARAM) str);
                    /*update text in edit box*/ SetDlgltemText(hdwnd, IDD_EB1,str);
                  else MessageBox(hdwnd, str, "No Title Matching", MB_OK); return 1;
  case IDD_LB1: /* process a list box LBN_DBLCLK */
    if(HIWORD(wParam)==LBN_DBLCLK) /* see  if user made a selection */
     {i=SendDlgltemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0);  /*get index*/
     sprintf(str, "%s\n%s\n%s, %u",books[i].title, books[i].author,books[i].publisher,
   books(i].copyright);
     MessageBox(hdwnd, str, "Selection Made", MB_OK);
     SendDlgItemMessage(hdwnd,IDD_LB1,LB_GETTEXT,i,(LPARAM)str);
     /*update edit box*/ SetDlgItemText(hdwnd, IDD_EBl, str); return 1;
case IDD_SELECT: /* Select Book button has been pressed */
  i = SendDlgltemMessage(hdwnd, IDD_LB1, LB_GETCURSEL, 0, 0);  /* get index */
  sprintf (str, "%s\n%s\n%s, %u", "books[i].title, books[i].author, books[i].publisher,
          books[i].copyright);
  MessageBox(hdwnd, str, "Selection Made", MB_OK);
  /*get string associated with that index*/
  SendDlgItemMessage(hdwnd, IDD_LBl, LB_GETTEXT, i, (LPARAM) str);
  /* update edit box */ SetDlgItemText(hdwnd, IDD_EB1, str); return 1;} break;
case WM_INITDIALOG: /* initialize list box */
  for(i = 0; i<NUMBOOKS; i + + )
    SendDlgItemMessage(hdwnd, IDD_LB1,LB_ADDSTRING, 0, (LPARAM)books[i].title);
   /* select first item */ SendDlgItemMessage(hdwnd, IDD_LB1, LB_SETCURSEL, 0, 0);
  /*initialize the edit box*/SetDlgItemText(hdwnd, IDD_EB1, books[0] .title);return 1;}return 0;}
```

Dialog Box


Demonstrate A Modeless Dialog Box
Dialog Help
Books Dialog Box
Author
Publisher
Copyright
Cancel
Java: The Complete Reference
Design and Evolution of C++
Inside OLE
Select Book
C: The Complete Reference
Title Search
Selection Made
Design and Evolution of C++
Bjarne Stroustrup
Addison-Wesley, 1994
OK
Exit
Quit the Program?
Yes
No

More Control (Dialog Box)

This lecture begins with a discussion of the scroll bar and illustrates its use in a short example program. Although scroll bars offer a bit more of a programming challenge than do the other standard controls, they are still quite easy to use. Next, check boxes and radio buttons are discussed. To illustrate the practical use of scroll bars, check boxes, and radio buttons, a simple countdown timer application is developed. You could use such a program as a darkroom timer, for example. In the process of developing the countdown timer, Windows timer interrupts and the **WM_TIMER** message are explored. The chapter concludes with a look at Windows static controls.

Scroll Bars

The scroll bar is one of Windows most important controls. Scroll bars exist in two forms. The first type of scroll bar is an integral part of a normal window or dialog box. These are called *standard scroll bars.* The other type of scroll bar exists separately as a control and is called a *scroll bar control.* Both types of scroll bars are managed in much the same way.

Activating the Standard Scroll Bars

For a window to include standard scroll bars, you must explicitly request it. For windows created using **CreateWindow()**, such as your application's main window, you do this by including the styles **WS_VSCROLL** and/or **WS_HSCROLL** in the style parameter. In the case of a dialog box, you include the **WS_VSCROLL** and/or **WS_HSCROLL** styles in the dialog box's definition inside its resource file. As expected, the **WS_VSCROLL** causes a standard vertical scroll bar to be included and **WS_HSCROLL** activates a horizontal scroll bar. After you have added these styles, the window will automatically display the standard vertical and horizontal scroll bars.

Receiving Scroll Bar Messages

Unlike other controls, a scroll bar control does not generate a **WM_COMMAND** message. Instead, scroll bars send either a **WM_VSCROLL** or a **WM_HSCROLL** message when either a vertical or horizontal scroll bar is accessed, respectively. The value of the low-order word of **wParam** contains a code that describes the activity. For the standard window scroll bars, **lParam** is zero. However, if a scroll bar control generates the message, then **lParam** contains its handle.

As mentioned, the value in **LOWORD(wParam)** specifies what type of scroll bar action has

taken place. Here are some common scroll bar values:

SB_LINEUP	SB_LINEDOWN
SB_PAGEUP	SB_PAGEDOWN
SB_LINELEFT	SB_LINERIGHT
SB_PAGELEFT	SB_PAGERIGHT
SB_THUMBPOSITION	SB_THUMBTRACK

For vertical scroll bars, each time the user moves the scroll bar up one position, **SB_LINEUP** is sent. Each time the scroll bar is moved down one position, **SB_LINEDOWN** is sent. **SB_PAGEUP** and **SB_PAGEDOWN** are sent when the scroll bar is moved up or down one page. For horizontal scroll bars, each time the user moves the scroll bar left one position, **SB_LINELEFT** is sent. Each time the scroll bar is moved right one position, **SB_LINERIGHT** is sent. **SB_PAGELEFT** and **SB_PAGERIGHT** are sent when the scroll bar is moved left or right one page.

For both types of scroll bars, the **SB_THUMBPOSITION** value is sent after the slider box (thumb) of-the scroll bar has been dragged to a new position. The **SB_THUMBTRACK** message is also sent when the thumb is dragged to a new position. However, it is sent each time the thumb passes over a new position. This allows you to "track" the movement of the thumb before it is released.

When **SB_THUMBPOSITION** or **SB_THUMBTRACK** is received, the high-order word of **wParam** contains the current slider box position.

SetScrollInfo( ) and GetScrollInfo( )

Scroll bars are, for the most part, manually managed controls. This means that in addition to responding to scroll bar messages, your program will also need to update various attributes associated with a scroll bar. For example, your program must update the position of the slider box manually. Windows contains two functions that help you manage scroll bars.

The first is **SetScrollInfo( ),** which is used to set various attributes associated with a scroll bar. Its prototype is shown here:

int SetScrollInfo(HWND *hwnd*, int *which*, LPSCROLLINFO *lpSI*, BOOL *repaint);

Here, *hwnd* is the handle that identifies the scroll bar. For window scroll bars, this is the handle of the window that owns the scroll bar. For scroll bar controls, this is the handle of the scroll bar itself. The value of *which* determines which scroll bar is affected. If you arc setting the

attributes of the vertical window scroll bar, then this parameter must be **SB_VERT.** If you are setting the attributes of the horizontal window scroll bar, this value must be **SB_HORZ.** However, to set a scroll bar control, this value must be **SB_CTL** and *hwnd* must be the handle of the control. The attributes are set according to the information pointed to by *lpSI* (discussed shortly). If *repaint* is true, then the scroll bar is redrawn. If false, the bar is not redisplayed. The function returns the position of the slider box.

To obtain the attributes associated with a scroll bar, use GctScroIIInfo(), shown here:

BOOL GetScrollInfo(HWND *hwnd*, int *which*, LPSCROLLINFO *lpSI);

The *hwnd* and *which* parameters are the same as those just described for **SetScrollInfo(**). The information obtained by **GetScrollInfo(**) is put into the structure pointed to by *lpSI*. The function returns nonzero if successful and zero on failure.

The *lpSI* parameter of both functions points to a structure of type **SCROLLINFO,** which is defined like this:

```
typedef struct tagSCROLLINFO
{UINT cbSize; /* size of SCROLLINFO */
  UINT fMask; /* Operation performed */
  int nMin; /* minimum range */
  int nMax; /* maximum range */
  UINT nPage; /* Page value */
  int nPos; /* slider box position */
  int nTrackPos; /* current tracking position */ } SCROLLINFO;
```

Here, **cbSize** must contain the size of the **SCROLLINFO** structure. The value or values contained in **fMask** determine which of the remaining members are meaningful. Specifically, when used in a call to **SetScrollInfo()**, the value in **fMask** specifies which scroll bar values will be updated. When used with **GctScrollInfo(**), the value in **fMask** determines which settings will be obtained. **fMask** must be one or more of these values. (To combine values, simply OR them together.)

SIF_ALL	Same as SIF_PAGE | SIF_POS | SIF_RANGE | SIF_TRACKPOS.
SIF_DISABLENOSCROLL	Scroll bar is disabled rather than removed if its range is set to zero.

SIF_P'AGE	nPage contains valid information.
SIF_P'OS	nPos contains valid information.
SIF_RANGE	nMin and nMax contain valid information.
SIF_TRACKPOS	nTrackPos contains valid information.

nPage contains the current page setting for proportional scroll bars.

nPos contains the position of the slider box.

nMin and **nMax** contain the minimum and maximum range of the scroll bar.

nTrackPos contains the current tracking position. The tracking position is the current position of the slider box while it is being dragged by the user. This value cannot be set.

Working with Scroll Bars

As stated, scroll bars are manually managed controls. This means that your program will need to update the position of the slider box within the scroll bar each time it is moved. To do this you will need to assign **nPos** the value of the new position, assign **fMask** the value **SIF_POS,** and then call **SetScrollInfo(**). For example, to update the slider box for the vertical scroll bar, your program will need to execute a sequence like the following:

```
SCROLLINFO si;
si.cbSize = sizeof(SCROLLINFO) ;
si.fMask = SIF_POS;
si.nPos = newposition;
SetScrollInfo(hwnd, SB_VERT, &si, 1);
```

The range of the scroll bar determines how many positions there are between one end and the other. By default, window scroll bars have a range of 0 to 100. However, you can set their range to meet the needs of your program. Control scroll bars have a default range of 0 to 0, which means that the range needs to be set before the scroll bar control can be used. (A scroll bar that has a zero range is inactive.)

A Sample Scroll Bar Program

The following program demonstrates both vertical and horizontal standard scroll bars. The scroll bar program requires the following resource file:

```
; Demonstrate scroll bars.
#include "scroll. h"
```

```
# include <windows.h>
MyMenu MENU {POPUP "&Dialog"{MENUITEM "&Scroll Bars\tF2", IDM_DIALOG
                                MENUITEM "&Exit\tF3", IDM_EXIT}
            MENUITEM "&Help", IDM_HELP}

MyMenu ACCELERATORS {VK_F2, IDM_DIALOG, VIRTKEY
                     VK_F3, IDM_EXIT, VIRTKEY
                     VK_F1, IDM_HELP, VIRTKEY}
MyDB DIALOG 18, 18, 142, 92 CAPTION "Using Scroll Bars"
STYLE DS_MODALFRAME |WS_POPUP |WS_VSCROLL |WS_HSCROLL
|WS_CAPTION | WS_SYSMENU { }
```

As you can see, the dialog box definition is empty. The scroll bars are added automatically because of the **WS_VSCROLL and WS_HSCROLL** style specifications.

You will also need to create this header tile, called SCROLL.H:

```
#define   IDM_DIALOG  100
#define   IDM_EXIT    101
#define   IDM_HELP    102
```

The entire scroll bar demonstration program is shown here. The vertical scroll bar responds to the **SB_LINEUP, SB_LINEDOWN, SB_PAGEUP, SB_PAGEDOWN, SB_THUMBPOSITION,** and **SB_THUMBTRACK** messages by moving the slider box appropriately. It also displays the current position of the thumb. The position will change as you move the slider. The horizontal scroll bar only responds to **SB_LINELEFT** and **SB_LINERIGHT.** Its thumb position is also displayed. (On your own, you might try adding the necessary code to make the horizontal scroll bar respond to other messages.) Notice that the range of both the horizontal and vertical scroll bar is set when the dialog box receives a **WM_INITDIALOG** message. You might want to try changing the range of the scroll-bars and observing the results. Sample output from the program is shown in Figure 7-1.

One other point: notice that the thumb position of each scroll bar is displayed by outputting text into the client area of the dialog box using TextOut( ). Although a dialog box performs a special purpose, it is still a window with the same basic characteristics as the main

```
window. /* Demonstrate Standard Scroll Bars */
#include <windows.h>
#include <string.h>
#include <stdio.h>
#include "scroll.h"
#define VERTRANGEMAX 200
#define HORZRANGEMAX 50
LRESULT CALLBACK WindowFunc(HWND, UINT, WPARAM, LPAAM);
BOOL CALLBACK DialogFunc(HWND, UINT, WPARAM, LPARAM);
char szWinName[ ] = "MyWin"; /* name of window class */
HINSTANCE hlnst;
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst,LPSTR
                   lpszArgs,int nWinMode)
{HWND hwnd; MSG msg; WNDCLASSEX wc1; HANDLE hAccel;
wc1.cbSize=sizeof(WNDCLASSEX);wc1.hInstance=hThisInst;
wc1.lpszClassName=szWinName;wc1.lpfnWndProc=WindowFunc;wc1.style= 0;
wc1.hIcon=LoadIcon(NULL,IDI_APPLICATION);
wc1.hIconSm=LoadIcon(NULL, IDI_WINLOGO);
wc1.hCursor = LoadCursor(NULL, IDC_ARROW); wc1.lpszMenuName="MyMenu";
wc1.cbClsExtra=0;wc1.cbWndExtra=0;
wc1.hbrBackground=GetStockObject(WHITE_BRUSH); if(!RegisterClassEx(&wc1)) return 0;
hwnd = CreateWindow(szWinName,"Managing Scroll Bars",WS_OVERLAPPEDWINDOW,
CW_USEDEFAULT,CW_USEDEFAULT,CW_USEDEFAULT,CW_USEDEFAULT,
HWND_DESKTOP, NULL, hThisInst, NULL);
hInst = hThisInst; /* save the current instance handle */
/* load accelerators */ hAccel = LoadAccelerators(hThisInst, "MyMenu");
ShowWindow(hwnd, nWinMode) ; UpdateWindow(hwnd) ;
while (GetMessage(&msg, NULL, 0, 0))
  {if ( ! TranslateAccelerator (hwnd, hAccel, &msg) )
       {TranslateMessage (&msg) ; /*translate keyboard messages*/
```

```
        DispatchMessage(&msg);/*return control to Windows */}
  }return msg.wParam;}
LRESULT CALLBACK WindowFunc(HWND hwnd, UINT message,
                                        WPARAM wParam, LPARAM lParam){ int response;
switch(message)
{case WM_COMMAND:
 switch(LOWORD(wParam))
 {case IDM_DIALOG: DialogBox(hInst,"MyDB", hwnd, (DLGPROC) DialogFunc) ; break;

  case IDM_EXIT: response=MessageBox(hwnd,"Quit the Program?","Exit", MB_YESNO);
                 if(response == IDYES) PostQuitMessage(0); break;
 case IDM_HELP: MessageBox(hwnd, "Try the Scroll Bar", "Help", MB_OK) break; }break;
 case WM_DESTROY: /* terminate the program */ PostQuitMessage(0);break;
default: return DefWindowProc(hwnd, message, wParam, lParam); } return 0;}
BOOL CALLBACK DialogFunc(HWND hdwnd, UINT message,WPARAM wParam,
LPARAM lParam) {char str[80]; static int vpos = 0;static int hpos= 0; static SCROLLINFO si;
HDC hdc; PAINTSTRUCT paintstruct;
switch(message) {
  case WM_COMMAND:
     swi tch(LOWORD(wParam))
        { case IDCANCEL: EndDialog(hdwnd, 0); return 1; }break;
         case WM_INITDIALOG: si.cbSize = sizeof(SCROLLINFO) ; si.fMask = SIF_RANGE;
                             si.nMin = 0; si.nMax = VERTRANGEMAX;
                             SetScrollInfo(hdwnd, SB_VERT, &si, 1);
                             si.nMax = HORZRANGEMAX;
                            SetScrollInfo(hdwnd, SB_HORZ, &si, 1); vpos = hpos = 0; return 1;
case WM_PAINT: hdc = BeginPaint(hdwnd, &paintstruct);
                sprintf(str, "Vertical: %d", vpos);
                TextOut(hdc, 1, 1, str, strlen(str));
               sprintf(str, "Horizontal: %d", hpos); TextOut(hdc, 1, 30, str, strlen(str));
```

```
                    EndPaint(hdwnd, &paintstruct); return 1;
case WM_VSCROLL:
  switch(LOWORD(wParam))
   {case SB_LINEDOWN:  vpos++;
                    if(vpos>VERTRANGEMAX) vpos = VERTRANGEMAX; break;
     case SB_LINEUP: vpos- -; if(vpos<0) vpos = 0; break;
    case SB_THUMBPOSITION: vpos = HIWORD(wParam); break;
     case SB_THUMBTRACK: vpos = HIWORD(wParam) break;
    case SB_PAGEDOWN: vpos += 5;
                    if(vpos>VERTRANGEMAX) vpos=VERTRANGEMAX; break;
    case SB_PAGEUP: vpos -= 5; if(vpos<0) vpos = 0;}
    /* update vertical bar position */      si.fMask = SIF_POS;     si.nPos = vpos;
       SetScrollInfo(hdwnd, SB_VERT, &si, 1);  hdc = GetDC(hdwnd);
       sprintf(str, "Vertical: %d   ", vpos); TextOut(hdc, 1, 1, str, strlen(str));
       ReleaseDC(hdwnd, hdc); return 1;,
case WM_HSCROLL:    switch(LOWORD(wParam)){/*Try adding the other event
handling code for the horizontal scroll bar, here. */
     case SB_LINERIGHT: hpos++;
                    if(hpos>HORZRANGEMAX) hpos=HORZRANGEMAX; break;
     case SB_LINELEFT: hpos- -; if(hpos<0) hpos = 0; break;
     case SB_THUMBPOSITION: hpos = HIWORD(wParam); break;
     case SB_THUMBTRACK: hpos = HIWORD(wParam) break;}
    /* update horizontal bar position */ si.fMask = SIF_POS;  si.nPos = hpos ;
    SetScrollInfo(hdwnd, SB_HORZ, &si, 1);hdc = GetDC(hdwnd);
     sprintf(str, "Horizontal-. %d   ", hpos); TextOut(hdc, 1, 30, str, strlen(str));
    ReleaseDC(hdwnd, hdc);  return 1;} return 0;}
```

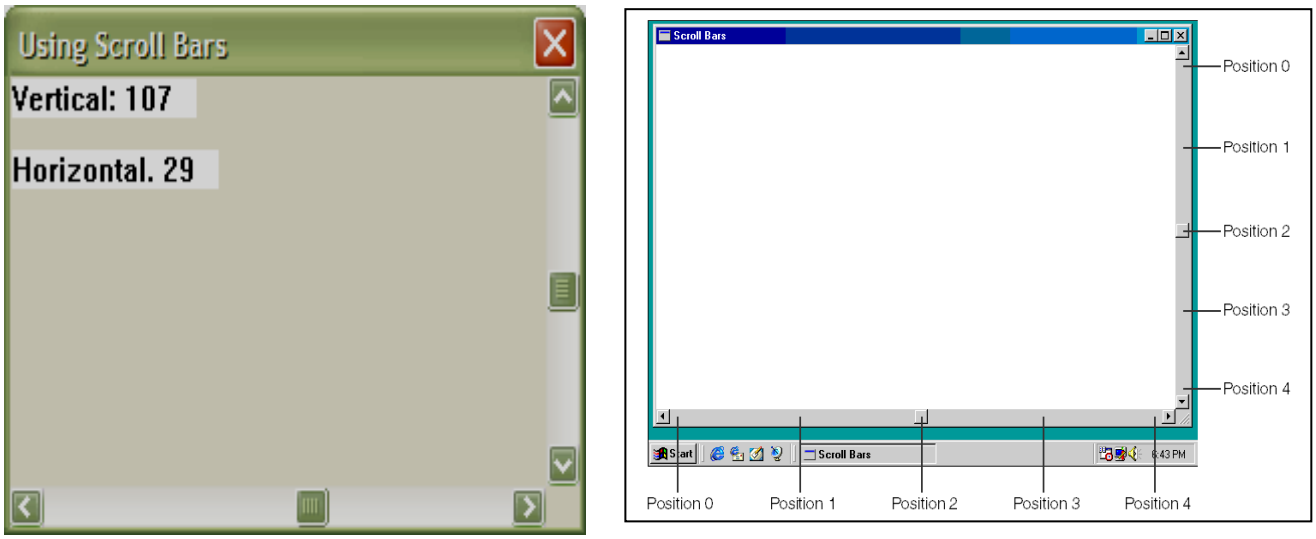


Figure 7-1 output of above program

Using a Scroll Bar Control

A scroll bar control is a stand-alone scroll bar; it is not attached to a window. Scroll bar controls are handled much like standard scroll bars, but two important differences exist. First, the range of a scroll bar control must be set because it has a default range of zero. Thus, it is initially inactive. This differs from standard scroll bars, whose default range is 0 to 100.

The second difference has to do with the meaning of **lParam** when a scroll bar message is received. Recall that all scroll bars — standard or control — generate a **WM_HSCROLL or a WM_VSCROLL** message, depending upon whether the scroll bar is horizontal or vertical. When these messages a generated by a standard scroll bar, **lParam** is always zero. However, when they are generated by a scroll bar control, the handle of the control is passed in **lParam.** In windows that contain both standard and control scroll bars, you will need to make use of this fact to determine which scroll bar generated the message.

Creating a Scroll Bar Control

To create a scroll bar control in a dialog box, use the **SCROLLBAR** statement, which has this general form: **SCROLLBAR** *SBID, X, Y, Width, Height [Style]*

Here, *SBID* is the value associated with the scroll bar. The scroll bar's upper left corner will be at *X*, Y and the scroll bar will have the dimensions specified by *Width* and *Height*. *Style* determines the exact nature of the scroll bar. Its default style is **SBS_HORZ,** which creates a horizontal scroll bar. For a vertical scroll bar, specify the **SBS_VERT** style. If you want the scroll bar to be able to receive keyboard focus, include the **WS_TABSTOP** style.

Demonstrating a Scroll Bar Control

To demonstrate a control scroll bar, one will be added to the preceding; program. First, change the dialog box definition as shown here. This version adds a vertical scroll bar control.

```
MyDB DIALOG 18, 18, 142, 92 CAPTION "Adding a Control Scroll Bar"
STYLE DS_MODALFRAME |WS_POPUP |WS_CAPTION |WS_SYSMENU
        |WS_VSCROLL   WS_HSCROLL
{
 SCROLLBAR ID_SB1, 110, 10, 10, 70, SBS_VERT | WS_TABSTOP
}
```

Then, add this line to SCROLL.H: *#define ID_SB1 200*

Next, you will need to add the code that handles the control scroll bar. This code must distinguish between the standard scroll bars and the scroll bar control, since both generate **WM_VSCROLL** messages. To do this, just remember that a scroll bar control passes its handle in **lParam.** For standard scroll bars, **lParam** is zero. For example, here is the **SB_LINEDOWN** case that distinguishes between the standard scroll bar and the control scroll bar.

```
case SB_LINEDOWN:
  if((HWND)lParam==GetDlgItem(hdwnd, ID_SBl)
    {/*is control scroll bar*/ cntlpos++;
     if(cntlpos>VERTRANGEMAX) cntlpos = VERTRANGEMAX;}
  else {/* is window scroll bar */ vpos++;
```

```
if(vpos>VERTRANGEMAX) vpos = VERTRANGEMAX;}break;
```

Here, the handle in **lParam** is compared with the handle of the scroll bar control, as obtained using **GetDIgItem()**. If the handles are the same, then the message was generated by the scroll bar control. If not, then the message came from the standard scroll bar.

As mentioned in Lecture 7, the **GetDIgItem()** API function obtains the handle of a control. Its prototype is: **HWND GetDlgItem(HWND *hDwnd*, int *ID);**

Here, *hDwnd* is the handle of the dialog box that owns the control. The control ID is passed in *ID*. This is the value you associate with the control in its resource file. The function returns the handle of the specified control or **NULL** on failure.

Here is the entire program that includes the vertical scroll bar control. It is the same as the preceding program except for the following additions: First, **DialogFunc()** defines the static variable **cntlpos,** which holds the position of the control scroll bar. Second, the control scroll bar is initialized inside **WM_INITDIALOG.** Third, all the handlers that process **WM_VSCROLL** messages determine whether the message came from the standard scroll bar or the control scroll bar. Finally, code has been added to display the current position of the control scroll bar.

Sample output is shown in Figure 7-2. On your own, try adding a horizontal control scroll bar. /* Demonstrate a Control Scroll Bar */

```
#include<windows.h>
#include<string.h>
#include<stdio.h>
#include"scroll.h"
#define VERTRANGEMAX 200
#define HORZRANGEMAX  50
LRESULT CALLBACK WindowFunc(HWND, UINT, WPARAM, LPARAM);
BOOL CALLBACK DialogFunc(HWND, UINT, WPARAM, LPARAM);
char szWinName[] = "MyWin"; /* name of window class */ HINSTANCE hInst;
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst, LPSTR lpszArgs, int
nWinMode) {HWND hwnd; MSG msg; WNDCLASSEX wc1;  HANDLE hAcce;
```

```
wc1.cbSize=sizeof(WNDCLASSEX);wc1.hInstance=hThisInst;
wc1.lpszClassName=szWinName; wc1.lpfnWndProc = WindowFunc; wc1.style = 0;
wc1.hIcon = LoadIcon(NULL, IDI_APPLICATION);
wc1.hIconSm = LoadIcon(NULL, IDI_WINLOGO);
wc1.hCursor = LoadCursor(NULL, IDC_ARROW); wc1. lpszMenuNarne = "MyMenu";
wc1.cbClsExtra = 0;wc1.cbWndExtra = 0;
wc1.hbrBackground = GetStockObject (WHITE_BRUSH),;  if(!RegisterClassEx(&wc1)) return 0;
hwnd = CreateWindow(szWinName, "Managing Scroll Bars", WS_OVERLAPPEDWINDOW,
CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT,
HWND_DESKTOP, NULL, hThisInst, NULL ); hInst = hThisInst;
hAccel = LoadAccelerators(hThisInst, "MyMenu");
ShowWindow(hwnd,nWinMode);  UpdateWindow(hwnd) ;
while (GetMessage (&msg, NULL, 0, 0))
{if ( ITranslateAccelerator (hwnd, hAccel, &msg) )
  {TranslateMessage (&msg) ;DispatchMessage (&msg) ;}}return msg.wParam;}
LRESULT CALLBACK WindowFunc(HWND hwnd,UINT message,WPARAM
wParam,LPARAM lParam) {int response;
switch (message)
{case WM_COMMAND:
 switch(LOWORD(wParam))
      {case IDM_DIALOG:DialogBox(hInst,"MyDB",hwnd, (DLGPROC) DialogFunc); break;
       case IDM_EXIT: response = MessageBoxfhwnd, "Quit the Program?","Exit" , MB_YESNO) ;
                                  if (response == IDYES) PostQuitMessage (0 ); break;
       case IDM_HELP: MessageBox(hwnd, "Try the Scroll Bar", "Help", MB_OK) break;
       }break;
case WM_DESTROY:  PostQuitMessage (0),break;
default: return DefWindowProc (hwnd, message, wParam, lParam); } return 0 ;}
BOOL CALLBACK DialogFunc(HWND hdwnd, UINT message,WPARAM wParam,
LPARAM IParam) {char str[80]; static int vpos = 0;static int hpos=0;static int cntlpos=0;
static SCROLLINFO si; HDC hdc;  PAINTSTRUCT paintstruct;
```

```
switch(message)
  {case WM_COMMAND:
            switch(LOWORD(wParam)) { case IDCANCEL: EndDialog(hdwnd, 0); return 1; }break;
    case WM_INITDIALOG:
       si.cbSize = sizeof(SCROLLINFO);
       si.fMask = SIF_RANGE;
      si.nMin = 0; si.nMax = VERTRANGEMAX;
/* set range of standard vertical scroll bar */ GetScrollInfo(hdwnd, SB_VERT, &si, 1);
/*set range of scroll bar control*/ SetScrollInfo(GetDlgltem(hdwnd, ID_SBl), SB_CTL, &si, 1)
     si.nMax = HORZRANGEMAX;
     /* set range of standard horizontal scroll bar */ SetScrollInfo(hdwnd, SB_HORZ, &si, 1);
    vpos = hpos = cntlpos = 0; return 1;
  case WM_PAINT:
     hdc = BeginPaint(hdwnd, kpaintstruct)
     sprintf(str, "Vertical: %d", vpos);
     TextOut(hdc, 1, 1, str, strlen(str));
     sprintf(str, "Horizontal: %d", hpos);
     TextOut(hdc, 1, 30, str, strlen(str))
     sprintf(str, "Scroll Bar Control: %d ",cntlpos);
     TextOutfhdc, 1, 60, str, strlen(str));
      EndPaint(hdwnd, &paintstruct); return 1;
case WM_VSCROLL:   switch(LOWORD(wParam)}
   {case SB_LINEDOWN:
      if ( (HWND) lParam==GetDlgItem(hdv:nd, ID_SB1))
 {/*is control scroll bar*/cntlpos++;  if(cntlpos>VERTRANGEKAX)
                                        cntlpos = VERTRANGEMAX; }
      else{/* is window scroll bar */ vpos++;
           if(vpos>VERTRANGEMAX) vpos = VERTRANGEMAX; }break;
    case SB_LINEUP:
      if((HWND)lParam==GetDlg!tem(hdwnd, ID_SBl))
```

```
    {/*is control scroll bar*/ cntlpos--;
      if(cntlpos<0) cntlpos = 0;}
      else{/* is window scroll bar */ vpos--; if(vpos<0) vpos = 0; }break;
case SB_THUMBPOSITION:
   if((HWND)lParam==GetDlgItern(hdwnd, ID_SB1))
    {/*is control scroll bar */cntlpos = HIWORD(wParam); /* get current position */ }
   else{/* is window scroll bar */vpos = HIWORD(wParam); /* get current position */}break;
case SB_THUMBTRACK:
   if((HWND)lParam==GetDlgItem(hdwnd, ID_SB1))
    {/*is control scroll bar*/ cntlpos = HIWORD(wParam); /* get current position */ }
   else{/*is window scroll bar*/ vpos = HIWORD(wParam); /* get current position */}break;
case SB_PAGEDOWN:
   if ( (HWND) lP.iram==GetDlgItem(hdwnd, ID_SB1))
   {/*is control scroll bar*/cntlpos + = 5; if(cntlpos>VERTRANGEMAX)
cntlpos=VERTRANGEMAX;}
  else{/*is window scroll bar*/vpos += 5;if(vpos>VERTRANGEMAX)
vpos=VERTRANGEMAX;}break;
case SB_PAGEUP:
  if((HWND)!Param==GetDlgItem(hdwnd, ID_SB1))
   {/*is control scroll bar */cntlpos -= 5; if(cntlpos<0) cntlpos = 0; }
 else {/* is window scroll bar */vpos -= 5;if(vpos<0) vpos = 0; } break; }
if((HWND)lParam==GetDlgItem(hdwnd, ID_SBl)) {
    /* update control scroll bar position */
   si.fMask = SIF_POS;
   si.nPos = cntlpos;
   SetScrollInfo((HWND)lParam, SB_CTL, &si, 1);
   hdc = GetDC(hdwnd);
   sprintffstr, "Scroll Bar Control: %d   ", cntlpos)
   TextOutthdc, 1, 60, str, strlen(str));   ReleaseDC(hdwnd, hdc); }
else {/*update standard scroll bar position */
```

```
        si.fMask = SIF_POS;
        si.nPos = vpos;
        SetScrollInfo(hdwnd, SB_VERT, &si, 1);
        hdc = GetDC(hdwnd);
        sprintf(str, "Vertical: %d  ", vpos);
        TextOut(hdc, 1, 1, str, strlen(str));
        ReleaseDC(hdwnd, hdc);} return 1;
case WM_HSCROLL:
    swi tch(LOWORD(wParam)) {
    /* Try adding the other event handling code for the horizontal scroll bar, here. */
      case SB_LINERIGHT: hpos++;
            if(hpos>HORZRANGEMAX) hpos = HORZRANGEMAX; break;
     case SB_LINELEFT: hpos--; if(hpos<0) hpos = 0; }
    /* update horizontal scroll bar position */ si.fMask = SIF_POS;
    si.nPos = hpos;
    SetScrollInfo(hdwnd, SB_HORZ, &si, 1);
     hdc = GetDC(hdwnd);
     sprintf(str, "Horizontal: %d   ", hpos);
    TextOutfhdc, 1, 30, str, strlen(str));
    ReleaseDC(hdwnd, hdc); return 1; }
 return 0;}
```

See in figure 8-2 of output above program

Figure 7-2 Output Program

Check Boxes

A *check box* is a control that is used to turn on or off an option. It consists of a small rectangle which can either contain a check mark or not. A check box has associated with it a label that describes what option the box represents. If the box contains a check mark, the box is said to be *checked* and the option is selected. If the box is empty, the option will be deselected.

A check box is a control that is typically part of a dialog box and is generally defined within the dialog box's definition in your program's resource file. To add a check box to a dialog box definition, use either the **CHECKBOX** or **AUTOCHECKBOX** command, which have these general forms:

CHECKBOX "string", CBID, X, Y, Width, Height [, Style]

AUTOCHECKBOX "string", CBID, X, Y, Width, Height [, Style]

Here, *string* is the text that will be shown alongside the check box. *CBID* is the value associated with the check box. The box's upper left corner will be at *X*, *Y* and the box plus its associated text will have the dimensions specified by *Width* and *Height. Style* determines the exact nature of the check box. If no explicit style is specified, then the check box defaults to displaying the *string* on the right and allowing the box to be tabbed to. When a check box is first created, it is unchecked.

As you know from using Windows NT, check boxes are toggles. Each time you select a check box, its state changes from checked to unchecked, and vice versa. However, this is not necessarily accomplished automatically. When you use the **CHECKBOX** resource command, you are creating a *manual check box,* which your program must manage by checking and unchecking the box each time it is selected. (That is, a manual check box must be manually toggled by your program.) However, you can have Windows perform this housekeeping function for you if you create an *automatic check box* using **AUTOCHECKBOX.** When you use an automatic check box, Windows automatically toggles its state (between checked and not checked) each time it is selected. Since most applications do not need to manually manage a check box, we will be using only **AUTOCHECKBOX** in the examples that follow.

Obtaining the State of a Check Box

A check box is either checked or unchecked. You can determine the status of a check box by sending it the message **BM_GETCHECK** using the **SendDlgItemMessage()** API function. **(SendDlgItemMessage( )** is described in Lecture 7.) When sending this message, both *wParam* and *lParam* are zero. The check box returns **BST_CHECKED** (1) if the box is checked and **BST_UNCHECKED** (0) otherwise.

Checking a Check Box

A check box can be checked by your program. To do this, send the check box **a BM_SETCHECK** message using **SendDlgItemMessage( )**. In this case, *wParam* determines whether the check box will be checked or cleared. If *wParam* is **BST_CHECKED,** the check box is checked. If it is **BST_UNCHECKED,** the box is cleared. In both cases, *lParam* is zero.

As mentioned, manual check boxes will need to be manually checked or cleared by your program each time they are toggled by the user. However, when using an automatic check box your program will need to explicitly check or clear a check box during program initialization only. When you use an automatic check box, the state of the box will be changed automatically each time it is selected.

Check boxes are cleared (that is, unchecked) each time the dialog box that contains them is activated. If you want the check boxes to reflect their previous state, then you must initialize them. The easiest way to do this is to send them the appropriate **BM_SETCHECK** messages when the dialog box is created. Remember, each time a dialog box is activated, it is sent a **WM_INITDIALOG** message. When this message is received, you can set the state of the check boxes (and anything else) inside the dialog box.

Check Box Messages

Each time the user clicks on the check box or selects the check box and then presses the space bar, a **WM_COMMAND** message is sent to the dialog function and the low-order word of **wParam** contains the identifier associated with that check box. If you are using a manual check box, then you will want to respond to this command by changing the state of the box.

IN DEPTH The 3-State Check Box

Windows provides an interesting variation of the check box called the *3-state check box.* This check box has three possible states: checked, cleared, or grayed. (When the control is grayed, it is disabled.) Like its relative, the 3-state check box can be implemented as either an automatic or manually managed control using the **AUTO3STATE** and **STATE3** resource commands, respectively. Their general forms are shown here:

STATES "string", ID, X, Y, Width, Height [, Style]

AUTO3STATE "string[1], ID, X, Y, Width, Height I Style]

Here, *string* is the text that will be shown alongside the check box. *ID* is the value associated with the check box. The box's upper left corner will be at *X*, *Y* and the box plus its associated text will have the dimensions specified by *Width* and *Height*. *Style* determines the exact nature of the check box. If no explicit style is specified, then the check box defaults to displaying the *string* on the right and allowing the box to be tabbed to. When a 3-state check box is first created, it is unchecked.

In response to a **BM_GETCHECK** message, 3-state check boxes return **BST_UNCHECKED** if unchecked, **BST_CHECKED** if checked, and **BST_INDETERMINATE** if grayed. Correspondingly, when setting a 3-statc check box using **BM_SETCHECK,** use **BST_UNCHECKED** to clear it, **BST_CHECKED** to check it, and **BST_INDETERMINATE** to gray it.

Radio Buttons

The next control that we will examine is the *radio button.* Radio buttons are used to present mutually exclusive options. A radio button consists of a label and a small circular button. If the button is empty, then the option is not selected. If the button is filled, then the option is selected. Windows NT supports two types of radio buttons: manual and automatic. The manual radio button (like the manual check box) requires that you perform all management functions. The automatic radio button performs the management functions for you. Because automatic radio buttons are used almost exclusively, they are the only ones examined here.

Like other controls, automatic radio buttons are defined in your program's resource file, within a dialog definition. To create an automatic radio button, use **AUTORADIOBUTTON,** which has this general form:

AUTORADIOBUTTON ***"string", RB1D, X, Y, Width, Height [, Style]***

Here, *string* is the text that will be shown alongside the button. *RBID* is the value associated with the radio button. The button's upper left corner will be at *X,Y*and the button plus its associated text will have the dimensions specified by *Width* and *Height*. *Style* determines the exact nature of the radio button. If no explicit style is specified, then the button defaults to displaying the *string* on the right and allowing the button to be tabbed to. By default, a radio button is unchecked.

As stated, radio buttons are generally used to create groups of mutually exclusive options. When you use automatic radio buttons to create such a group, then Windows automatically manages the buttons in a mutually exclusive manner. That is, each time the user selects one button, the previously selected button is turned off. Also, it is not possible for the user to select more than one button at any one time.

A radio button (even an automatic one) may be set to a known state by your program by sending it the **BM_SETCHECK** message using the **SendDlgItemMessage( )**function. The value of *wParam* determines whether the button will be checked or cleared. If *wParam* is **BST_CHECKED,** then the button will be checked. If it is **BST_UNCHECKED,** the box will be cleared. By default, a radio button is unchecked. You can obtain the status of a radio button by sending it the **BM_GETCHECK** message. The button returns **BST_CHECKED** if the button is selected and **BST_UNCHECKED** if it is not.

Generating Timer Messages

Using Windows, it is possible to establish a timer that will interrupt your program at periodic intervals. Each time the timer goes off, Windows sends a **WM_TIMER** message to your program. Using a timer is a good way to "wake up your program" every so often. This is particularly useful when your program is running as a background task. To start a timer, use the **SetTimer( )** API function, whose prototype is shown here:

UINT SetTimer(HWND *hwnd*, UINT *ID*, UINT *wLength*, TIMERPROC *lpTFunc);*

Here, *hwnd* is the handle of the window that uses the timer. Generally, this window will be

either your program's main window or a dialog box window. The value of *ID* specifies a value that will be associated with this timer. (More than one timer can be active.) The value of *wLength* specifies the length of the period, in milliseconds. That is, *wLength* specifies how much time there is between interrupts. The function pointed to by *lpTFunc* is the timer function that will be called when the timer goes off. However, if the value of *lpTFunc* is **NULL,** then the window function associated with the window specified by *hwnd* will be called each time the timer goes off and there is no need to specify a separate timer function. In this case, when the timer goes off, a **WM_TIMER** message is put into your program's message queue and processed like any other message. This is the approach used by the example that follows. The **SetTimer( )** function returns *ID* if successful. If the timer cannot be allocated, zero is returned. If you wish to define a separate timer function, it must be a callback function that has the following prototype (of course, the name of the function may be different):

VOID CALLBACK TFunc(HWND hwnd, UINT msg, UINT TimerID, DWORD SysTime);

Here, *hwnd* will contain the handle of the timer window, *msg* will contain the message **WM_TIMER,** *TimerlD* will contain the ID of the timer that went off, and *SysTime* will contain the current system time.

Once a timer has been started, it continues to interrupt your program until you either terminate the application or your program executes a call to the **KillTimer()** API function, whose prototype is shown here: **BOOL KillTimer(HWND *hwnd,* UINT *ID);**

Here, *hwnd* is the window that contains the timer and *ID* is the value that Identifies that particular timer. The function returns nonzero if successful and zero on failure.

Each time a **WM_TIMER** message is generated, the value of **wParam** contains the ID of the timer and **lParam** contains the address of the timer callback function (if it is specified). For the example that follows, **lParam** will be **NULL.**

The Countdown Timer Resource and Header Files

The countdown timer uses the following resource file:

```
; Demonstrate scroll bars, check boxes, and radio buttons.
#include "cd.h"
#include <windows.h>
```

```
MyMenu MENU{POPUP "&Dialog"{MENUITEM "&Timer\tF2", IDM_DIALOG
                            MENUITEM "&Exit\tF3", IDM EXIT}
           MENUITEM "&Help", IDM_HELP}
MyMenu ACCELERATORS {VK_F2, IDM_DIALOG, VIRTKEY
                     VK_F3, IDM_EXIT, VIRTKEY
                     VK_F1, IDM_HELP, VIRTKEY}

MyDB DIALOG 18, 18, 152, 92 CAPTION "A Countdown Timer"
STYLE DS_MODALFRAME | WS_POPUP | WS_VSCROLL |WS_CAPTICN | WS_SYSMENU
{PUSHBUTTON "Start", IDD_START, 10, 60, 30, 14, WS_CHILD | WS_VISIBLE | WS_TABSTOP
 PUSHBUTTON "Cancel", IDCANCEL, 60, 60, 30, 14,WS_CHILD | WS_VISIBLE | WS_TABSTOP
 AUTOCHECKBOX "Show Countdown", IDD_CB1, 1, 20, 70, 10
 AUTOCHECKBOX "Beep At End", IDD_CB2, 1, 30, 50, 10
 AUTORADIOBUTTON "Minimize", IDD_RB1, 80, 20, 50, 10
 AUTORADIQBUTTON "Maximize", IDD_RB2, 80, 30, 50, 10
 AUTORADIOBUTTON "As-Is", IDD_RB3, 80, 40, 50, 10}
```

The header file required by the timer program is shown here. Call this file CD.H.

```
#define     IDM_DIALOG   100
#define     IDM_EXIT   101
#define     IDM_HELP   102
#define     IDD_START   300
#define     IDD_TIMER   301
#define     IDD_CB1   400
#define     IDD_CB2   401
#define     IDD_RB1   402
#define       IDD_RE2   403
#define       IDD_RB3   404
```

The Countdown Timer Program

The entire countdown timer program is shown here. Sample output from this program is shown in Figure 7-3. /* A Countdown Timer */

```
#include <windows.h>
#include <string.h>
#include <stdio.h>
#include "cd.h"
#define VERTRANGEMAX 200
LRESULT CALLBACK WindowFunc(HWND, UINT, WPARAM, LPARAM);
BOOL CALLBACK DialogFunc(HWND, UINT, WPARAM, LPARAM);
char szWinName[ ] = "MyWin"; /* name of window class */
HINSTANCE hlnst; HWND hwnd;
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst,LPSTR IpszArgs, int nWinMode)
{MSG  msg; WNDCLASSEX wc1; HANDLE hAccel;
wc1.cbSize=sizeof(WNDCLASSEX);wc1.hInstance=hThisInst;
wc1.lpszClassName=szWinName; wc1.lpfnWndProc = WindowFunc; wc1.style = 0;
wc1.hIcon =   LoadIcon(NULL, IDI_APPLICATION);
wc1.hlconSm= Loadlcon(NULL, IDI_WINLOGO);
wc1.hCursor   = LoadCursor(NULL, IDC_ARROW);
wc1.lpszMenuName="MyMenu";wc1.cbClsExtra=0;wc1.cbWndExtra=0;
wc1.hbrBackground= GetStockObject(WHITE_BRUSH); if ( !RegisterClassEx(&wc1) ) return 0;
hwnd = CreateWindow(szWinName, "Demonstrating Controls",WS_OVERLAPPEDWINDOW,
CW_USEDEFAULT,CW_USEDEFAULT,CW_USEDEFAULT,CW__USEDEFAULT,
HWND_DESKTOP, NULL, hThisInst, NULL ); hInst = hThisInst;
/* load accelerators */ hAccel = LoadAccelerators (hThisInst, "MyMenu");
/*Display the window.*/ ShowWindow(hwnd, nWinMode); UpdateWindow(hwnd) ;
while (GetMessagef^msg, NULL, 0, 0))
{if ( ITranslateAccelerator (hwnd, hAccel, &msg) )
  {TranslateMessage (&msg) ;DispatchMessage (&msg) ;} } return msg.wParam;}
```

```
LRESULT CALLBACK WindowFunc (HWND hwnd, UINT message, WPARAM wParam,LPARAM lParam) { int response;
 switch (message)
   {case WM_COMMAND:
      switch (LOWORD(wParam) )
        { case IDM_DIALOG: DialogBox(hInst, "MyDB", hwnd, (DLGPROC) DialogFunc); break;
          case IDM_EXIT: response=MessageBox (hwnd,"Quit the Program?","Exit" , MB_YESNO) ;
                         if (response == IDYES) PostQuitMessage (0) ; break;
         case IDM_HELP: MessageBox (hwnd, "Try the Timer", "Help", MB_OK) ; break;
          }break;
   case WM_DESTROY: /* terminate the program */ PostQuitMessage (0) ; break;
    default:  return DefWindowProc (hwnd, message, wParam, lParam) ; } return 0;}
BOOL CALLBACK DialogFunc (HWND hdwnd, UINT message, WPARAM wParam, LPARAM lParam) {char str [80] ;static int vpos=0;static SCROLLINFO si;
HDC hdc; PAINTSTRUCT paintstruct ; static int t;
switch(message)
 {case WM_COMMAND:
      switch (LOWORD (wParam) )
       {case IDCANCEL: EndDialog (hdwnd, 0) ; return 1;
        case IDD_START: /* start the timer */
          SetTimer (hdwnd, IDD_TIMER, 1000, NULL) ; t = vpos ;
      if(SendDlgItemMessage(hdwnd,IDD_RB1,BM_GETCHECK,0,0)==BST_CHECKED)
             ShowWindow(hwnd, SW_MINIMIZE);
      Else if(SendDlgltemMessage(hdwnd,IDD_RB2,BM_GETCHECK,0,0) ==BST_CHECKED)
           ShowWindow(hwnd, SW_MAXIMIZE); return 1;}break;
     case WM_TIMER: if(t==0) {KillTimer(hdwnd, DD_TIMER); /*timer went off*/
            if(SendDlgltemMessage(hdwnd,IDD_CB2,BM_GETCHECK,0,0)==BST_CHECKED)
             MessageBeep (MB_OK) ;  MessageBox(hdwnd, "Timer Went Off", "Timer", MB_OK);
           ShowWindow(hwnd, SW_RESTORE); return 1;}
          t- -;/*see if countdown is to be displayed*/
```

```
        if(SendDlgItemMessage(hdwnd,IDD_CB1, BM_GETCHECK, 0, 0) == BST_CHECKED)
            {hdc = GetDC(hdwnd); sprintf(str, "Counting: %d   ", t);
            TextOutthdc, 1, 1, str, strlen(str)); ReleaseDC(hdwnd, hdc);return 1;
case WM_INITDIALOG:
      si.cbSize = sizeof(SCROLLINFO);
      si.fMask = SIF_RANGE;
      si.nMin = 0; si.nMax = VERTRANGEMAX;
      SetScrollInfo(hdwnd, SB_VERT, &si, 1);
      /* check the As-Is radio button */
       SendDlgItemMessage(hdwnd,IDD_RB3,BM_SETCHECK, BST_CHECKED, 0); return 1

ca se WM_PAINT:
       hdc = BeginPaint(hdwnd, &paintstruct);
      sprintf(str, "Interval: %d", vpos);
      TextOutthdc, 1, 1, str, strlen(str));
        EndPaint (hdwnd, &paintstruct) ,-  return 1;
case WM_VSCROLL:
 switch (LOWORD(wParam) )
{case SBLINEDOWN: vpos++;
                        if(vpos>VERTRANGEMAX) vpos=VERTRANGEMAX;  break;
 case SB_LINEUP: vpos--; if(vpos<0) vpos = 0;break;
 case SB_THUMBPOSITION: vpos = HIWORD(wParam); /*get current position*/break;
 case SB_THUMBTRACK: vpos = HIWORD(wParam); /* get current position */break;
case SB_PAGEDOWN: vpos += 5;
                          if(vpos>VERTRANGEMAX)  vpos=VERTRANGEMAX; break;
case  SB_PAGEUP: vpos  -=  5; if(vpos<0)   vpos  =  0; }
   si.fMask = SIF_POS;
   si.nPos   = vpos;
    SeCScrollInfoCndwnd,   SB_VERT,   &si,   1);
    hdc   =  GetDC(hdwnd);
```

```
sprintf(str, "Interval: %d ", vpos); TextOutfhdc, 1, 1, str, strlen(str));
ReleaseDCM hdwnd, hdc); return 1;} return 0; }
```

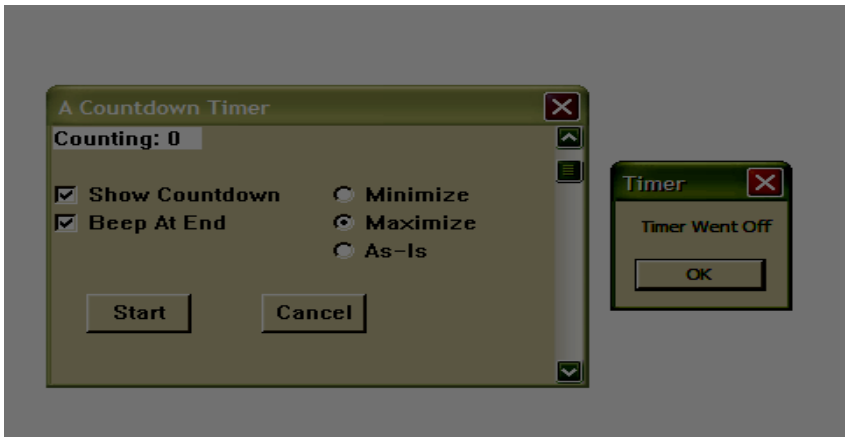


Figure 7-3 Output Count-Down Time Program

A Closer Look at the Countdown Program

To better understand how each control in the countdown program operates, let's take a closer look at it now. As you can see, the vertical scroll bar is used to set the delay. It uses much of the same code that was described earlier In this chapter when scroll bars were examined and no further explanation is needed. However, the code that manages the check boxes and radio buttons deserves detailed attention.

As mentioned, by default no radio button is checked when they are first created. Thus, the program must manually select one each time the dialog box is activated. In this example, each time a **WM_INITDIALOG** message Is received, the As-Is radio button **(IDD_RB3)** is checked using this statement. *SendDlgItemMessage(hdwnd, IDD_RB3, BM_SETCHECK, BST_CHECKED, 0);*

To start the timer, the user presses the Start button. This causes the following code to execute:

```
case IDD_START:/*start the timer*/ SetTimer(hdwnd, IDD_TIMER, 1000,NULL);t=vpos;
    if(SendDlgltemMessage(hdwnd, IDD_RB1, BM_GETCHECK, 0, 0) == BST_CHECKED)
```

```
        ShowWindow (hwnd, SW_MINIMIZE) ;
    else if (SendDlgItemMessage (hdwnd,IDD_RB2, BM_GETCHECK, 0, 0) ==
  BST_CHECKED)
            ShowWindow(hwnd, SW_MAXIMIZE); return 1;
```

Here, the timer is set to go off once every second (1,000 milliseconds). The value of the counter variable **t** is set to the value determined by the position of the vertical scroll bar. If the Minimize radio button is checked, the program windows are minimized. If the Maximize button is checked, the program windows are maximized. Otherwise, the program windows are left unchanged. Notice that the main window handle, **hwnd,** rather than the dialog box handle, **hdwnd,** is used in the call to **ShowWindow().** To minimize or maximize the program, the main window handle-not the handle of the dialog box—must be used. Also, notice that **hwnd** is a global variable in this program.

This allows it to be used inside **DialogFunc( ).** Each time a **WM_TIMER** message is received, the.following code executes:

```
case WM_TIMER: /* timer went off */
  if(t==0) { KillTimer(hdwnd, IDDJTIMER);
       if(SendDlgltemMessage(hdwnd,IDD_CB2, BM_GETCHECK, 0, 0) == BST_CHECKED)
            MessageBeep(MB_OK);
             MessageBox(hdwnd, "Timer Went Off", "Timer", MB_OK);
            ShowWindow(hwnd, SW_RESTORE) ; return 1;} t- -;
/* see if countdown is to be displayed */
if(SendDlgltemMessage(hdwnd,IDD_CB1, BM_GETCHECK, 0, 0) == BST_CHECKED)
  {hdc = GetDC(hdwnd);
    sprintf(str, "Counting: %d   ", t) ;
  TextOut(hdc, 1, 1, str, strlen(str));
  ReleaseDC(hdwnd, hdc); } return 1;
```

If the countdown has reached zero, the timer is killed, a message box informing the user that the specified time has elapsed is displayed, and the window is restored to its former size, if necessary. If the Beep At End button Is checked, then the computer's speaker is beeped using a call to the API function **MessageBeep( ).** If there is still time remaining, then the counter

variable t is decremented. If the Show Countdown button is checked, then the time remaining in the countdown is displayed.

MessageBeep() is a function you will probably find useful in other programs that you write. Its prototype is shown here: **BOOL MessageBeep(UINT *sound);***

Here, *sound* specifies the type of sound that you want to make. It can be -1, which produces a standard beep, or one of these built in values:

MB_ICONASTERISK	MB_ICONEXCLAMATION	MB_ICONHAND
MB_ICONQUESTION	MB_OK	

MB_OK also produces a standard beep. **MessageBeep()** returns nonzero if successful or zero on failure.

As you can see by looking at the program, since automatic check boxes and radio buttons arc mostly managed by Windows, there is surprisingly little code within the countdown program that actually deals with these two controls. In fact, the ease of use of check boxes and radio buttons helps make them two of the most commonly used control elements.

Static Controls

Although none of the standard controls are difficult to use, there is no question that the static controls are the easiest. The reason for this is simple: a *static control* is one that neither receives nor generates any messages. In short, the term static control is just a formal way of describing something that is simply displayed in a dialog box. Static controls include **CTEXT, RTEXT,** and **LTEXT,** which are static text controls; and **GROUPBOX,** which is used to visually group other controls.

The **CTEXT** control outputs a string that is centered within a predefined area. **LTEXT** displays the string left justified. **RTEXT** outputs the string right justified. The general forms for these controls are shown here:

CTEXT *"text", ID, X, Y, Width, Height [, Style]*

RTEXT *'text", ID, X, Y, Width, Height [, Style]*

LTEXT *"text", ID, X, Y, Width, Height* [, *Style]*

Here, *text* is the text that will be displayed. *ID* is the value associated with the text. The text will be shown in a box whose upper left corner will be at *X, Y* and whose dimensions are specified by *Width* and *Height. Style* determines the exact nature of the text box. Understand that the box itself is *not* displayed. The box simply defines the space that the text is allowed to occupy.

The static text controls provide a convenient means of outputting text to a dialog box. Frequently, static text is used to label other dialog box controls or to provide simple directions to the user. You will want to experiment with the static text controls on your own.

A group box is simply a box the surrounds other dialog elements and is generally used to visually group other items. The box may contain a title. The general form for **GROUPBOX** is shown here: **GROUPBOX *"title", ID, X, Y, Width, Height [, Style]***

Here, *title* is the title to the box. *ID* is the value associated with the box. The upper left corner will be at X,Yand its dimensions are specified by Width and Height. Style determines the exact nature of the group box. Generally, the default setting is sufficient.

To see the effect of a group box, add the following definition to the resource file you created for the countdown program. `GROUPBOX "Display As", 1, 72, 10, 60, 46`

After you have added the group box, the dialog box will look like that shown in Figure 7-4. Remember that although a group box makes the dialog box look different, its function has not been changed.

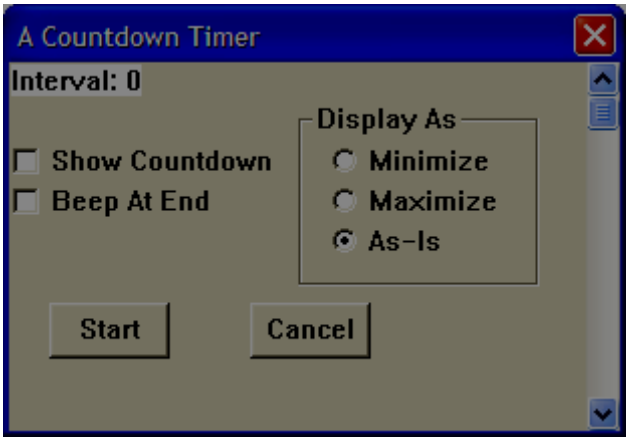


Figure 7-4 The Count-Down dialog box that includes a group box static control

Stand Alone Controls

Although controls are most often used within a dialog box, they may also be free-standing within the client area of the main window. To create a free-standing control, simply use the **CreateWindow( )** function, specifying the name of the control class and the style of control that you desire. The standard control class names are shown here:

BUTTON
COMBOBOX
EDIT
L1STBOX
SCROLLBAR
STATIC

Each of these classes has several style macros associated with it that can be used to customize the control. However, it is beyond the scope of this book to describe them. A list of these style macros can be found by examining WINDOWS.H (and its support files) or by referring to an API reference guide.

The following code creates a free-standing scroll-bar and push button.

```
hsbwnd = CreateWindow(
    "SCROLLBAR", /* name of scroll bar class */
    "", /* no title */
    SBS_HORZ | WS_CHILD | WS_VISIBLE, /* horizontal scroll bar */
    10, 10, /* position */
    120, 20, /* dimensions
  hwnd, /* parent window */
  NULL, /* no control ID needed for scroll bar */
  hThisInst, /* handle of this instance of the program */
  NULL /* no additional arguments */
```

```
hpbwnd = CreateWindow(
  "BUTTON", /* name of pushbutton class */
  "Push Button", /* text inside button */
  BS_PUSHBUTTON | WS_CHILD | WS_VISIBLE, /* pushbutton*/
  10, 60, /* position */
  90, 30, /* dimensions */
  hwnd, /* parent window */
  (HWND) 500, /* control ID*/
  hThisInst, /* handle of this instance of the program */
  NULL /* no additional arguments */);
```

As the push button shows, when required, the ID associated with a free-standing control is specified in the ninth parameter to **CreateWindow( ).** As you should recall, this is the parameter that we used to specify the handle of a menu that overrides the class menu. However, when creating a control, you use this parameter to specify the control's ID.

When a free-standing control generates a message, it is sent to the parent window. You will need to add code to handle these messages within the parent's window function.

Bitmap

---

*A **bitmap*** is a display object that contains a rectangular graphical image. The term comes from the fact that a bitmap contains a set of bits which defines the image. Since Windows is a graphics-based operating system, it makes sense that you can include graphical images as resources in your applications. However, bitmaps have broader application than simply providing support for graphical resources. As you will see, bitmaps underlie many of the features that comprise the Windows graphical user interface. They can also help solve one of the must fundamental programming problems facing the Windows programmer: repainting a window. Once you gain mastery over the bitmap you are well on your way to taking charge of many other aspects of Windows. In addition to bitmaps proper, there are two specialized types: the **icon** and the **cursor**. As you know, an icon represents some resource or object. The cursor indicates the current mouse position. So far, we have only been using built-in icons and cursors. Here you will learn to create your own, custom versions of these items.

Two Types of Bitmaps

There are two general types of bitmaps supported by Windows: device-dependent and device-independent. Device-dependent bitmaps (DDE) are designed for use with a specific device. Device-independent bitmaps (DIB) are not tied to a specific device. Device-dependent bitmaps were initially the only type available in Windows. However, all versions of Windows since 3.0 have included device-independent bitmaps, too. DIBs are most valuable when you are creating a bitmap that will be used in environments other than the one in which it was created. For example, if you want to distribute a bitmap, a device-independent bitmap is the best way to do this. However, DDEs are still commonly used when a program needs to create a bitmap for its own, internal use. In fact, this is the main reason that DDEs remain widely used. Also, Win32 provides various functions that allow you to convert between DDEs and DIBs, should you need

to. The organization of a DDB differs from that of a DIB. However, for the purposes of this chapter, the differences are not important. In fact, the binary format of a bitmap is seldom significant from the application's perspective because Windows provides high-level API functions that manage bitmaps,you will seldom need to "get your hands dirty" with their internals. For the purposes of this chapter, we will be using device-dependent bitmaps because we will be focusing on bitmaps used by the program that creates them.

Two Ways to Obtain a Bitmap

A bitmap can be obtained two different ways: it may be specified resource or it may be created dynamically, by your program, resource is a graphical image that is defined outside your program, but specified in the program's resource file. A dynamic bitmap is created by your program during its execution. Each type is discussed in this chapter, beginning with the bitmap resource.

Using a Bitmap Resource

In general, to use a bitmap resource you must follow these three steps:

1. The bitmap must be specified within your program's resource file.
2. The bitmap must be loaded by your program.
3. The bitmap must be selected into a device context.

This section describes the procedures necessary to accomplish these steps.

Creating a Bitmap Resource

Bitmap resources are not like the resources described in the preceding chapters, such as menus, dialog boxes, and controls. These resources are defined using textual statements in a resource file. Bitmaps are graphical images that must reside in special, bitmap files. However, the bitmap must still be referred to in your program's resource file. A bitmap resource is typically created using an *image editor*. **An image editor** will usually be

supplied with your compiler. It displays an enlarged view of your bitmap. This allows you easily to construct or alter the image example; a custom bitmap is displayed inside the Microsoft C++ image editor.

Except for specialized bitmaps, such as icons and cursors, the It bitmap is arbitrary and under your control. Within reason, you can create bitmaps as large or as small as you like. To try the example that bitmap must be 256 x 128 pixels. Call your bitmap file BP.BMP. if you want your program to produce the results shown in the figures in this chapter, then make your bitmap look like the one shown you have defined your bitmap, create a resource file called BP.RC that contains this line.

As you can guess, the **BITMAP** statement defines a bitmap resource called **MyBP** that is contained in the file BP.BMP. The general form of the **BITMAP** statement is:

BitmapName *BITMAP* Filename

Here, BitmapName *is the name that identifies the bitmap. This name is used by your program to refer to the bitmap.* Filename *is the name of the file that contains the bitmap.*

Displaying a Bitmap

Once you have created a bitmap and included it in your application's resource file, you may display it whenever you want in the client area of a window. However, displaying a bitmap requires a little work on your part. The following discussion explains the proper procedure.

Before you can use your bitmap, you must load it and store its handle. This can be done inside **WinMain( )** or when your application's main window receives a **WM_CREATE** message. A **WM_CREATE** message is sent to a window when it is first created, out before it is visible. **WM_CREATE** is a good place to perform any initializations that relate to (and are subordinate to) a window. Since the bitmap resource will be displayed

Bitmap

---

within the client area of the main window, it makes sense to load the bitmap when the window receives the **WM_CREATE** message. This is the approach that will be used in this chapter. To load the bitmap, use the **LoadBitmap( )** API function, whose prototype is shown here:

HBITMAP LoadBitmap(HINSTANCE hThisInst, LPCSTR lpszName);

The current instance is specified in hThisInst and a pointer to the name of the bitmap as specified in the resource file is passed in lpszName. The function returns the handle to the bitmap, or **NULL** if an error occurs. For example:

```
HBITMAP hbit; /* handle of bitmap */
/*……*/
hbit = LoadBitmap(hInst, "MyBP"); /* load bitmap */
```

This fragment loads a bitmap called **MyBP** and stores a handle to it in **hbit.**

When it comes time to display the bitmap, your program must follow these four steps:

1. Obtain the device context so that your program can output to the window.
2. Obtain an equivalent memory device context that will hold the bitmap until it is displayed. (A bitmap is held in memory until it is copied to your window.)
3. Select the bitmap into the memory device context.
4. Copy the bitmap from the memory device context to the window device context. This causes the bitmap to be displayed.

To see how the preceding four steps can be implemented, consider the following fragment. It causes a bitmap to be displayed at two different locations each time a **WM_PAINT** message is received.

```
HOC hdc,  memdc; PAINTSTRUCT  ps;

case WM_PAINT:
```

Bitmap

```
hdc = BeginPaint(hwnd, &ps); /* get device context */
memdc = CreateCompatibleDC(hdc); /* create compatible DC */
SelectObject(memdc, hbit); /* select bitmap */
/*display image */
BitBlt(hdc,10,10,256,128,memdc,0,0,SRCCOPY);
/* display image */
BitBlt(hdc,300,100,256,128,memdc,0,0,SRCCOPY);
EndPaint(hwnd, &ps); /* release DC */
DeleteDC(memdc); /* free the memory context */ break;
```

Let's examine this code, step by step.

First, two device context handles are declared, **hdc** will hold the current window device context as obtained by **BeginPaint( ).** The other, called **memdc,** will hold the device context of the memory that stores the bitmap until it is drawn in the window.

Within the **WM_PAINT** case, the window device context is obtained. This is necessary because the bitmap will be displayed in the client area of the window and no output can occur until your program is granted a device context. Next, a memory context is created that will hold the bitmap. This memory device context must be compatible with the window device context. The compatible memory device context is created using the **CreateCompatibleDC( )** API function. Its prototype is shown here: **HDC CreateCompatibleDC(HDC *hdc);***

This function returns a handle to a region of memory that is compatible with the device context of the window, specified by *hdc*. This memory will be used to construct an image before it is actually displayed. The function returns **NULL** if an error occurs.

Bitmap

Next, the bitmap must be selected into the memory device context using the **SelectObject()** API function. Its prototype is shown here:

HGDIOBJ SelectObject(HDC *hdc*, HGDIOBJ *hObject);

Here, *hdc* specifies the device context and *hObject* is the handle of the object being selected into that context. The function returns the handle of the previously selected object (if one exists), allowing it to be reselected later, if desired.

To actually display the bitmap, use the **BitBlt()** API function. This function copies a bitmap from one device context to another. Its prototype is shown here:

BOOL BitBlt(HDC *HDest*, int *X*, int *Y*, int *Width*, int *Height*, HDC *hSource*, int *SouceX*, int *SourceY*, DWORD *dwHow);

Here, *hDcst* is the handle of the target device context, and *X* and Fare the upper left coordinates at which point the bitmap will be drawn. The width and height of the destination region are specified in *Width* and *Height.* The *hSource* parameter contains the handle of the source device context, which in this case will be the memory context obtained using **CreateConipatibleDC( ).** The *SourceX* and *SourceY* parameters specify the upper left coordinates within the bitmap at which the copy operation will begin. To begin copying at the upper-left corner of the bitmap, these values must be zero. The value of *dwHow* determines how the bit-by-bit contents of the bitmap will be drawn on the screen. Some of the most common values are shown here:

Macro	Effect
DSTINVERT	Inverts the bits in the destination bitmap
SRCAND	ANDs bitmap with current destination.
SRCCOPY	Copies bitmap as is, overwriting any preexisting output.

SRCPA1NT	ORs bitmap with current destination.
SRCINVERT	XORs bitmap with current destination.

BitBlt( ) returns nonzero if successful and zero on failure.

In the example, each call to **BitBlt( )** displays the entire bitmap by copying it to the client area of the window.

After the bitmap is displayed, both device contexts are released. In this case, **EndPaint()** is called to release the device context obtained by calling **BeginPaint( )**. To release the memory device context obtained using **CreateCompatibleDC( ),** you must use **DeleteDC( ),** which takes as its parameter the handle of the device context to release. You cannot use **ReleaseDC( )** for this purpose. (Only a device context obtained through a call to GetDC() can be released using a call to **ReleaseDC( )**.)

Deleting a Bitmap

A bitmap is a resource that must be removed before your application ends. To do this, your program must call **DeleteObject( )** when the bitmap is no longer needed or when a **WM_DESTROY** message is received. **DeleteObject()** has this prototype:

BOOL DeleteObject(HGDIOBJ *hObj);

Here, *hObj* is the handle to the object being deleted. The function returns nonzero if successful and zero on failure.

The Complete Bitmap Example Program

```
#include <windows.h>
```

Bitmap

```
#include <string.h>
#include <stdio.h>
LRESULT CALLBACK WindowFunc (HWND, UINT, WPARAM, LPARAM);
char szWinName[] = "MyWin"; /* name of window class */
HBITMAP hbit; /* handle of bitmap */
HINSTANCE hlnst; /* handle to this instance */
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst,
  LPSTR IpszArgs, int nWinMode)
{HWND hwnd; MSG msg; WNDCLASSEX wcl;
/* Define a window class. */
 wcl.cbSize = sizeof(WNDCLASSEX);
wcl.hInstance = hThisInst; /* handle to this instance */
wcl.lpszClassName = szWinName; /* window class name */
wcl.lpfnWndProc = WindowFunc; /* window function */
wcl.style = 0; /* default style */
wcl.hIcon = LoadIcon(NULL, IDI_APPLICATION); /* standard icon */
wcl.hIconSm = LoadIcon(NULL, IDI_APPLICATION); /* small icon */
wcl.hCursor = LoadCursor(NULL, IDC_ARROW); /*cursor style */
wcl.lpszMenuName = NULL; /* no main menu */
wcl.cbClsExtra = 0; /* no extra */
wcl.cbWndExtra =0; /* information needed */
/* Make the window white. */
 wcl.hbrBackground =(HBRUSH) GetStockObject(WHITE_BRUSH);
/* Register the window class. */
 if(!RegisterClassEx(&wcl)) return 0;
```

Bitmap

```
hlnst = hThisInst; /* save instance handle */
/* Now that a window class has been registered, a window can be created. */
hwnd = CreateWindow(
szWinName, /* name of window class */
"Displaying a Bitmap", /* title */
 WS_OVERLAPPEDWINDOW, /* window style - normal */
 CW_USEDEFAULT, /* X coordinate - let Windows decide */
 CW_USEDEFAULT, /* Y coordinate - let Windows decide */
 CW_USEDEFAULT, /* width - let Windows decide */
 CW_USEDEFAULT, /* height - let Windows decide */
 HWND_DESKTOP, /* no parent window */
 NULL, /* no override of class menu */
hThisInst, /* handle of this instance of the program */
 NULL /* no additional arguments */ );
/* Display the window. */ ShowWindow(hwnd, nWinMode);
UpdateWindow(hwnd) ;
/* Create the message loop. */
 while (GetMessage(&msg, NULL, 0, 0))
{TranslateMessage(&msg) ; /* translate keyboard messages */
 DispatchMessage(&msg) ; /* return control to Windows */}
return msg.wParam;}
/* This function is called by Windows and is passed messages from the message
queue. */ LRESULT CALLBACK WindowFunc (HWND hwnd, UINT message,
WPARAM wParam, LPARAM lParam)
{HDC hdc, memdc; PAINTSTRUCT ps;
```

Bitmap

```
switch (message) { case WM_CREATE: /* load the bitmap */
hbit = LoadBitmap (hlnst, "MyBP"); /* load bitmap */ break;
        case WM_PAINT: hdc = BeginPaint (hwnd, &ps); /*get device context */
memdc= CreateCompatibleDC(hdc); /* create compatible DC */
SelectObject(memdc, hbit); /* select bitmap */
BitBlt(hdc,10,10,256,128,memdc, 0, 0, SRCCOPY); /* display image */
BitBlt(hdc,300,100,256,128,memdc, 0, 0, SRCCOPY); /* display image */
EndPaint(hwnd, &ps); /* release DC */
DeleteDC(memdc); /* free the memory context */ break;
    case WM_DESTROY: /* terminate the program */
DeleteObject(hbit); /* remove the bitmap */ PostQuitMessage(0); break;
default: return DefWindowProc(hwnd, message, wParam, lParam);} return 0;}
```

You might want to experiment with the bitmap program before continuing. For example, try using different copy options with **BitBlt()**. Also, try bitmaps of differing sizes.

In Depth:

XORing an Image to a Window

As explained, **BltBlt( )** can copy the bitmap contained in one device context into another device context a number of different ways. For example, if you specify **SRCPAINT,** the image is ORed with the destination. Using **SRSCAND** causes the bitmap to be ANDed with the destination. Perhaps the most interesting way to copy the contents of one DC to another uses **SRCINVERT.** This method XORs the source with the destination. There are two reasons this is particularly valuable.

Bitmap

First, XORing an image onto a window guarantees that the image will be visible. It doesn't matter what color or colors the source image or the destination uses; an XORed image is always visible. Second, XORing an image to the same destination twice removes the image and restores the destination to its original condition. As you might guess, XORing is an efficient way to temporarily display and then remove an image from a window without disturbing its original contents.

To see the effects of XORing animage to a window, insert the following cases into **WindowFunc(**) in the first bitmap program.

```
case WM_LBUTTONDOWN: hdc = GetDC(hwnd) ;
rnemdc = CreateCompatibleDC (hdc) ,- /* create compatible DC */
 SelectObjoct (memdc, hbit); /* select bitmap */
/* XOR image onto the window */
BitBlt(hdc, LOWORD ( lParam) , HIWORD ( lParam) ,256,128,memdc, 0, 0, SRCINVERT);
ReleaseDC(hwnd, hdc); DeleteDC (memdc) ; break;
case WM_LBUTTONUP :hdc = GetDC(hwnd) ;
memdc = CreateCompatibleDC (hdc) ; /* create compatible DC *?
 SelectObject (memdc, hbit); /* select bitmap */
  /* XOR image onto the window a second time */
   BitBlt(hdc,LOWORD(lParam) , HIWORD(lParam),256, meradc,0,0, SRCINVERT) ;
ReleaseDC(hwnd, hdc); De1eteDC (memdc) ; break;
```

The code works like this: Each time the left mouse button is pressed, the bitmap is XORed to the window starting at the location of the mouse pointer. This causes an inverted image of the bitmap to be displayed. When the left mouse pointer is released, the image is XORed a second time, causing the bitmap to be removed and the previous contents to be

restored. Be careful not to move the mouse while you are holding down the left button. If you do, then the second XOR copy will not take place directly over the top of the first and the original contents of the window will not be restored.

Creating a Custom Icon and Cursor

To conclude this chapter we will examine the creation and use of custom icons and cursors. As you know, all Windows NT applications first create a window class, which defines the attributes of the window, including the shape of the application's icon and mouse cursor. The handles to the icons and the mouse cursor are stored in the **hIcon, hIconSm,** and **hCursor** fields of the **WNDCLASSEX** structure. So far, we have been using the built-in icons and cursors supplied by Windows NT. However, it is possible to define your own.

Defining Icons and Cursors

To use a custom icon and mouse cursor, you must first define their images, using an image editor. Remember, you will need to make both a small and a standard-size icon. Actually, icons come in three sizes: small, standard, and large. The small icon is 16*16, the standard icon is 32*32, and the large icon is 48*48. However, the large icon is seldom used. In fact, most programmers mean the 32*32 icon when they use the term "large icon". All three sizes of icons are defined within a single icon file. Of course, you don't need to define the large icon. If one is ever needed, Windows will automatically enlarge the standard icon. All cursors are the same size, 32*32.

Bitmap

For the examples that follow, you should call the file that holds your icons ICON.ICO. Be sure to create both the 32 x 32 and the 16 x 16 icons. (The 48 * 48 icon is not needed.) Call the file that holds your cursor CURSOR.CUR.

Once you have defined the icon and cursor images, you will need to add an **ICON** and a **CURSOR** statement to your program's resource file. These statements have these general forms: *IconName* ICON *filename*

CursorName CURSOR *filename*

Here, *IconName* is the name that identifies the icon and *CursorName* is the name that identifies the cursor. These names are used by your program to refer to the icon and cursor. The *filename* specifies the file that holds the custom icon or cursor.

For the example program, you will need a resource file that contains the following statements: MyCursor CURSOR CURSOR.CUR

Mylcon ICON YAHOO.ICO

Loading Your Icons and Cursor

To use your custom icons and cursor, you must load them and assign their handles to the appropriate fields in the **WNDCLASSEX** structure before the window class is registered. To accomplish this you must use the API functions **Loadlcon( )** and **LoadCursor(**), which you learned about in Chapter 2. For example, the following loads the icons identified as **Mylcon** and the cursor called **MyCursor** and stores their handles In the appropriate fields of **WNDCLASSEX.**

```
wcl.hIcon=Loadlcon (hThisInst, "Mylcon"); /* standard icon */
wcl.hIconSm = NULL; /* use small icon in Mylcon */
wcl.hCursor = LoadCursor(hThisInst, "MyCursor"); /* load cursor */
```

Here, **hThisInst** is the handle of the current instance of the program. In the previous programs in this book, these functions have been used to load default icons and cursors. Here, they will be used to load your custom icons and cursor.

You are probably wondering why **hIconSm** is assigned **NULL.** As you should recall, in previous programs the handle of the small icon is assigned to the **hIconSm** field of the **WNDCLASSEX** structure. However, if this value is **NULL,** then the program automatically uses the 16x16 pixel icon defined in the file that holds the standard icon. Of course, you are free to specify a different icon resource for this icon, if you like.

A Sample Program that Demonstrates a-Custom Icon and Cursor

The following program uses the custom icons and cursor. The small icon is displayed in the main window's system menu box and in the program's entry in the task bar. The standard icon is displayed when you move your program to the desktop. The cursor will be used when the mouse pointer is over the window. That is, the shape of the mouse cursor will automatically change to the one defined by your program when the mouse mow* HI program's window. It will automatically revert to its default shape when it moves off the program's window.

Remember, before you try to compile this program, you musl define custom icons and cursor using an image editor and then add UICIM |f to the resource file associated with the program.

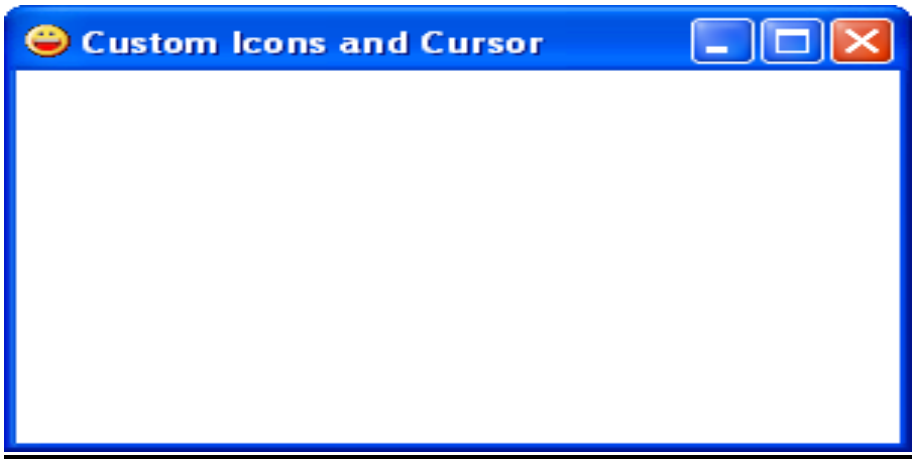
```
/* Demonstrate custom icons and mouse cursor. */
#include <windows.h>
#include <string.h>
#include <stdio.h>
```

Bitmap

```
LRESULT CALLBACK WindowFunc(HWND, UINT, WPARAM, LPARAM);
 char szWinName[]="MyWin" ; /* name of window class. */
int WINAPI WinMain(HINSTANCE hThisInst, HINSTANCE hPrevInst, LPSTR lpszArgs,int nWinMode)
{HWND hwnd; MSG msg;WNDCLASSEX wcl;
wcl.cbSize = sizeof(WNDCLASSEX);wcl.hInstance=hThisInst;
wcl.lpszClassName=szWinName;wcl.lpfnWndProc=WindowFunc;
wcl.style = 0;wcl.hIcon=LoadIcon(hThisInst, "MyIcon");
wcl.hIconSm=NULL;
wcl.hCursor=LoadCursor(hThisInst, "MyCursor");
wcl.lpszMenuName=NULL;wcl.cbClsExtra =0; wcl.cbWndExtra=0;
wcl.hbrBackground=(HBRUSH)GetStockObject(WHITE_BRUSH);
/* Register the window class. */if(!RegisterClassEx(&wcl)) return 0;
hwnd=CreateWindow(szWinName,"Custom Icons and Cursor",
 WS_OVERLAPPEDWINDOW, 10, 20, 300, 400,
 HWND_DESKTOP, NULL, hThisInst, NULL);
ShowWindow (hwnd, nWinMode);UpdateWindow(hwnd);
while (GetMessage(&msg, NULL, 0, 0))
{TranslateMessage(&msg); DispatchMessage(&msg); }
return msg.wParam;}
LRESULT CALLBACK WindowFunc(HWND hwnd, UINT message, WPARAM wParam, LPARAM lParam)
```

Bitmap

```
{switch(message)
{case WM_DESTROY: PostQuitMessage(0); break;
default: return DefWindowProc(hwnd, message, wParam, lParam); }
return 0;}
```



Of course, your custom icon may look different. The custom mouse cursor will appear when you move the mouse over the window. (Try this before continuing.)

One last point about custom icons: When you create custom icons for your application, you will usually want all sizes of icons to display the same general image since it is this image that is associated with your program.