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Using VBA to Programmatically Add All Standard Form Controls to a UserForm

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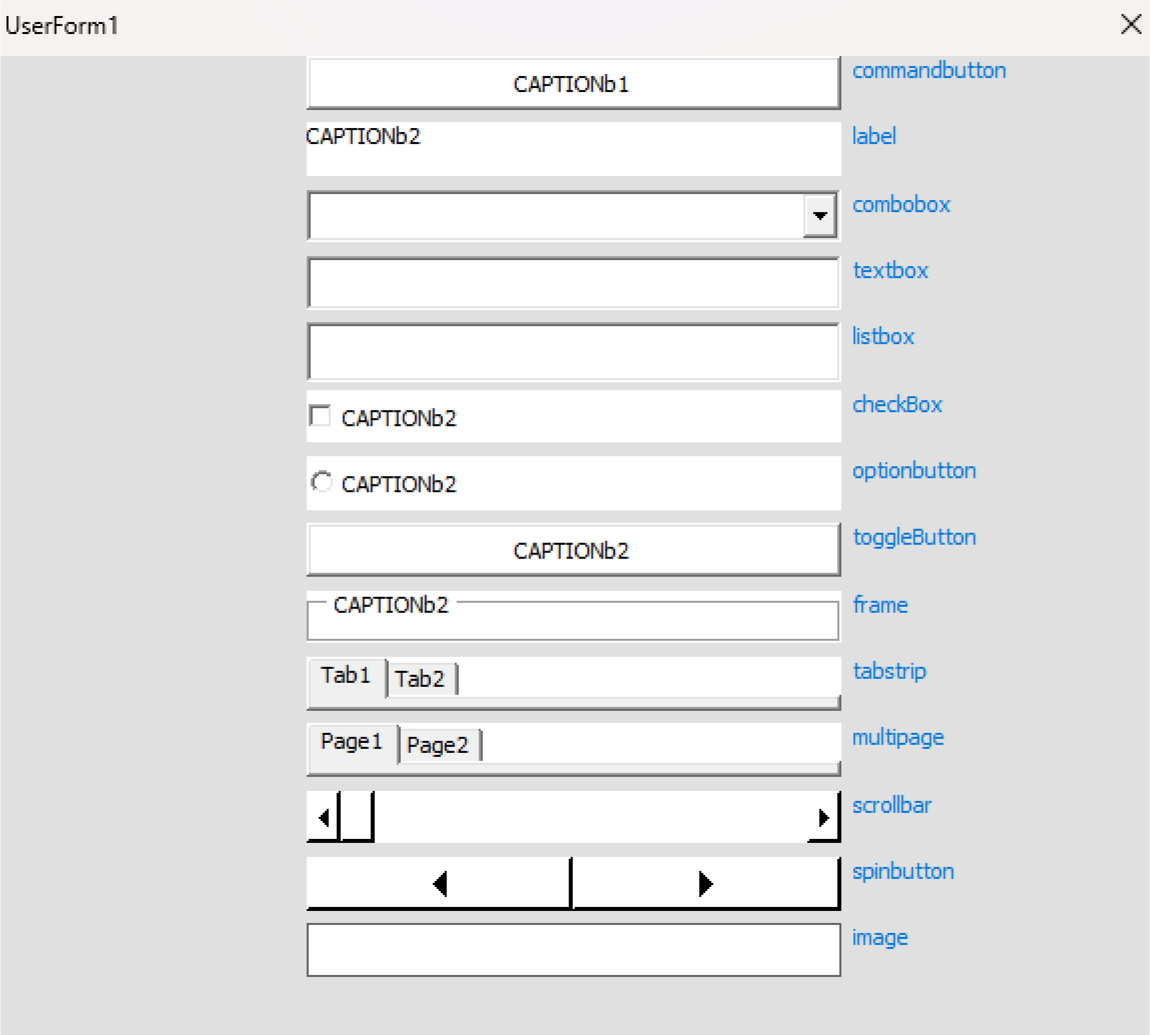
All Standard Form Controls to a UserForm



Contents

Abstract

This paper identifies the methods employed in dynamically adding all standard form control to a UserForm, with a focus on the mathematical rationale behind the top positioning of these controls.

Introduction

The creation of a UserForm in VBA involves initializing a container (USERFORMb) and programmatically adding manually or programmatically all the standard controls such as CommandButton, Label, ComboBox, TextBox, ListBox, CheckBox, OptionButton, ToggleButton, Frame, TabStrip, MultiPage, ScrollBar, SpinButton, and Image. The placement of each control within the UserForm is determined by precise calculations of the top position between controls, ensuring a structured and intuitive user interface. To guide the design of the user interface, the following research question will be addressed.

Research Question

Rather than adding manually, how can the dynamic addition and precise positioning of standard form controls within a UserForm, utilizing Visual Basic for Applications (VBA), facilitate the user interface design in Excel applications?

Background

The development of user interfaces in VBA may require a dynamic and flexible approach to adding and arranging form controls. This need arises from the diverse requirements of various applications, demanding a method that allows for the automated placement and customization of controls.

Objective

The goal of this project is to demonstrate a systematic approach to programmatically adding and positioning all standard form controls on a UserForm in Excel VBA, thereby enhancing the efficiency of user interface development.

Methods

This study employs Microsoft Excel 365 with Visual Basic for Applications (VBA), facilitating the programmatic addition and precise positioning of standard form controls within a UserForm. The methodology is grounded in the capabilities afforded by the integrated development environment (IDE) of Excel and VBA, enabling a systematic approach to the design and implementation of user interfaces. The initial phase involved creating a foundational code structure to instantiate a default UserForm, designated as USERFORMb. This foundational code is incorporated into the subroutine AllStandardFormControl.

```
Sub AllStandardFormControl()
Dim USERFORMb As Object
Set USERFORMb = ThisWorkbook.VBProject.VBComponents.Add(3) ' 3 denotes a UserForm
VBA.UserForms.Add(USERFORMb.Name).Show
End Sub
```

Subsequent to this initialization, we extended the UserForm's attributes by specifying its dimensions:

```
USERFORMb.Properties("Width") = 350
USERFORMb.Properties("Height") = 600
```

Following the establishment of the UserForm's dimensions, the study progressed to the development of our first subroutine named AddCommandButton, which is designed to facilitate the addition of a CommandButton control to USERFORMb:

```
Sub AddCommandButton(USERFORMb As Object, ByVal Name As String, ByVal Caption As String,
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.CommandButton.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height
If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If
End Sub
```

To systematically add any controls to the UserForm, constants defining the left position (Leftb), width (Widthb), and initial top position (Topb) were declared within AllStandardFormControl, laying the groundwork for control placement:

```
Const Leftb As Integer = 70
Const Widthb As Integer = 200
Const Topb As Integer = 0
```

Utilizing these constants, AddCommandButton was invoked to add the first command button control to USERFORMb, marking the beginning of the sequential addition of form controls:

```
AddCommandButton USERFORMb, "NAMEb1", "CAPTIONb1", Leftb, Topb, Widthb, , RGB(255, 255, 255)
```

The methodology embraced a modular approach, where subroutines tailored to each standard form control type were developed and invoked within **AllStandardFormControl** subroutine. This included controls ranging from **AddCommandButton** to **AddImage**, each meticulously added to **USERFORMb** using specific parameters and the **Controls.Add** method. The top position of each successive control was calculated using the formula: **Topb + n * OptionalHeight + n *5**, where **n** is the ordinal index of the control, **OptionalHeight** is a constant reflecting the standard height adjustment (20 pixels in this context), and **increment** ensures appropriate spacing. The complete code can be found in appendix A and B.

Results

The application of this approach results in a UserForm where all standard controls are added to a UserForm. The output generated by the **AllStandardFormControl** subroutine is provided on page 2.

Keywords

VBA, UserForm, Programmatically Adding Controls, Form Controls

Learning Objective

Readers should understand the importance of a structured approach to adding form controls in VBA, all of which is done programmatically rather than manually.

Conclusion

The choice between adding manually or programmatically form controls to a UserForm is dependent on the context the VBA programmer faces. This paper, with its content, , Leveraging Excel 365 and VBA, proposes a structured methodology for the dynamic creation of a UserForm along with all standard form controls as we know them.

Appendix A- VBA Code for Adding UserForm Controls

```
Sub AllStandardFormControl ()
Const Leftb As Integer = 70
Const Widthb As Integer = 200
Const Topb As Integer = 0

Dim USERFORMb As Object
Set USERFORMb = ThisWorkbook.VBProject.VBComponents.Add(3) ' 3 denotes a UserForm
USERFORMb.Properties("Width") = 350
USERFORMb.Properties("Height") = 600

' Add CommandButton
AddCommandButton USERFORMb, "NAMEb1", "CAPTIONb1", Leftb, 0 * 20 + 0, Widthb, , RGB(255, 255, 255)

' Add Label
AddLabel USERFORMb, "NAMEb2", "CAPTIONb2", Leftb, 1 * 20 + 5, Widthb, , RGB(255, 255, 255)

' Add ComboBox
AddComboBox USERFORMb, "NAMEb3", "CAPTIONb2", Leftb, 2 * 20 + 10, Widthb, , RGB(255, 255, 255)

' Add Textbox
AddTextbox USERFORMb, "NAMEb4", "CAPTIONb2", Leftb, 3 * 20 + 15, Widthb, , RGB(255, 255, 255)

' Add Listbox
AddListbox USERFORMb, "NAMEb5", "CAPTIONb2", Leftb, 4 * 20 + 20, Widthb, 25, RGB(255, 255, 255)

' Add CheckBox
AddCheckBox USERFORMb, "NAMEb6", "CAPTIONb2", Leftb, 5 * 20 + 25, Widthb, , RGB(255, 255, 255)

' Add OptionButton
```

```
AddOptionButton USERFORMb, "NAMEb7", "CAPTIONb2", Leftb, 6 * 20 + 30, Widthb, , RGB(255, 255, 255)

' Add ToggleButton
AddToggleButton USERFORMb, "NAMEb8", "CAPTIONb2", Leftb, 7 * 20 + 35, Widthb, , RGB(255, 255, 255)

' Add Frame
AddFrame USERFORMb, "NAMEb9", "CAPTIONb2", Leftb, 8 * 20 + 40, Widthb, , RGB(255, 255, 255)

' Add Tabstrip
AddTabstrip USERFORMb, "NAMEb10", "CAPTIONb2", Leftb, 9 * 20 + 45, Widthb, , RGB(255, 255, 255)

' Add Multipage
AddMultipage USERFORMb, "NAMEb11", "CAPTIONb2", Leftb, 10 * 20 + 50, Widthb, , RGB(255, 255, 255)

' Add Scrollbar
AddScrollbar USERFORMb, "NAMEb12", "CAPTIONb2", Leftb, 11 * 20 + 55, Widthb, , RGB(255, 255, 255)

' Add Spinbutton
AddSpinbutton USERFORMb, "NAMEb13", "CAPTIONb2", Leftb, 12 * 20 + 60, Widthb, , RGB(255, 255, 255)

' Add Image
AddImage USERFORMb, "NAMEb14", "CAPTIONb2", Leftb, 13 * 20 + 65, Widthb, , RGB(255, 255, 255)

VBA.UserForms.Add(USERFORMb.Name).Show
End Sub
```

Appendix B- VBA Code for Adding Form Controls

```
Sub AddCommandButton(USERFORMb As Object, ByVal Name As String, _
ByVal Caption As String, ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.CommandButton.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If

End Sub
```

```
Sub AddLabel(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.label.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If

End Sub
```

```
Sub AddComboBox(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.ComboBox.1")
'CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddTextbox(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Textbox.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddListbox(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Listbox.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddCheckBox(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.CheckBox.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddOptionButton(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.OptionButton.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddToggleButton(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.ToggleButton.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If

End Sub
```

```
Sub AddFrame(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Frame.1")
CommandButtonb.Name = Name
CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddTabstrip(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Tabstrip.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddMultipage(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Multipage.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If



End Sub
```

```
Sub AddScrollbar(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Scrollbar.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If

End Sub
```

```
Sub AddSpinbutton(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Spinbutton.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

```
Sub AddImage(USERFORMb As Object, ByVal Name As String, ByVal Caption As String, _
ByVal Left As Single, ByVal Top As Single, ByVal Width As Single, _
Optional ByVal Height As Single = 20, Optional ByVal BackColor As Long)
Dim CommandButtonb As Object
Set CommandButtonb = USERFORMb.Designer.Controls.Add("Forms.Image.1")
CommandButtonb.Name = Name
'CommandButtonb.Caption = Caption
CommandButtonb.Left = Left
CommandButtonb.Top = Top
CommandButtonb.Width = Width
CommandButtonb.Height = Height

If Not IsMissing(BackColor) Then
CommandButtonb.BackColor = BackColor
End If


End Sub
```

Appendix C- Supplemental Code for Labeling Form Controls

it's noted that an additional set of VBA code was utilized in the main subroutine for the purpose of labeling each form control within the UserForm. This supplementary code segment, not primarily focused on within the body of this article, served to provide descriptive labels adjacent to each control. This code was executed to dynamically generate labels indicating the type of each control positioned on the right side of the UserForm, using an adjusted left position and a narrower width to fit the labels neatly beside their corresponding controls. The label creation subroutine was invoked as follows:

```
AddLabel USERFORMb, "NAMEbl1", "commandbutton", Leftb + 205, 0 * 20 + 0, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for CommandButton
AddLabel USERFORMb, "NAMEbl2", "label", Leftb + 205, 1 * 20 + 5, WIDTHb- 140, , RGB(255,
255, 255) ' Label for Label
AddLabel USERFORMb, "NAMEbl3", "combobox", Leftb + 205, 2 * 20 + 10, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for ComboBox
AddLabel USERFORMb, "NAMEbl4", "textbox", Leftb + 205, 3 * 20 + 15, WIDTHb- 140, , RGB(255,
255, 255) ' Label for TextBox
AddLabel USERFORMb, "NAMEbl5", "listbox", Leftb + 205, 4 * 20 + 20, WIDTHb- 140, , RGB(255,
255, 255) ' Label for ListBox
AddLabel USERFORMb, "NAMEbl6", "checkBox", Leftb + 205, 5 * 20 + 25, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for CheckBox
AddLabel USERFORMb, "NAMEbl7", "optionbutton", Leftb + 205, 6 * 20 + 30, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for OptionButton
AddLabel USERFORMb, "NAMEbl8", "toggleButton", Leftb + 205, 7 * 20 + 35, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for ToggleButton
AddLabel USERFORMb, "NAMEbl9", "frame", Leftb + 205, 8 * 20 + 40, WIDTHb- 140, , RGB(255,
255, 255) ' Label for Frame
AddLabel USERFORMb, "NAMEbl10", "tabstrip", Leftb + 205, 9 * 20 + 45, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for TabStrip
AddLabel USERFORMb, "NAMEbl11", "multipage", Leftb + 205, 10 * 20 + 50, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for MultiPage
AddLabel USERFORMb, "NAMEbl12", "scrollbar", Leftb + 205, 11 * 20 + 55, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for ScrollBar
AddLabel USERFORMb, "NAMEbl13", "spinbutton", Leftb + 205, 12 * 20 + 60, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for SpinButton
AddLabel USERFORMb, "NAMEbl14", "image", Leftb + 205, 13 * 20 + 65, WIDTHb- 140, ,
RGB(255, 255, 255) ' Label for Image
```

Appendix D- Streamlining Form Control Positioning

To streamline the AllStandardFormControl code and factorize the Topb position, we can use the formula 25 * n where n is a whole number ranging from 0 to 13 for each form control, the code can be improved as follows:

```
Sub AllStandardFormContro()
Const Leftb As Integer = 150
Const WIDTHb As Integer = 200
Dim n As Integer ' Control index variable

Dim USERFORMb As Object
Set USERFORMb = ThisWorkbook.VBProject.VBComponents.Add(3) ' 3 denotes a UserForm
USERFORMb.Properties("Width") = 500
USERFORMb.Properties("Height") = 500

' Initialize n to 0 for the first control
n = 0
AddCommandButton USERFORMb, "NAMEb1", "CAPTIONb1", Leftb, 25 * n, WIDTHb, , RGB(255,
255, 255)
n = 1
AddLabel USERFORMb, "NAMEb2", "CAPTIONb2", Leftb, 25 * n, WIDTHb, , RGB(255, 255, 255)
n = 2
AddComboBox USERFORMb, "NAMEb3", "CAPTIONb2", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)
n = 3
AddTextbox USERFORMb, "NAMEb4", "CAPTIONb2", Leftb, 25 * n, WIDTHb, , RGB(255, 255, 255)
n = 4
AddListbox USERFORMb, "NAMEb5", "CAPTIONb5", Leftb, 25 * n, WIDTHb, , RGB(255, 255, 255)
' AddListbox
n = 5
AddCheckBox USERFORMb, "NAMEb6", "CAPTIONb6", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)    ' AddCheckBox



n = 6
AddOptionButton USERFORMb, "NAMEb7", "CAPTIONb7", Leftb, 25 * n, WIDTHb, , RGB(255,
255, 255)    ' AddOptionButton
n = 7
```

```
AddToggleButton USERFORMb, "NAMEb8", "CAPTIONb8", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)  ' AddToggleButton
n = 8
AddFrame USERFORMb, "NAMEb9", "CAPTIONb9", Leftb, 25 * n, WIDTHb, , RGB(255, 255, 255)
' AddFrame
n = 9
AddTabstrip USERFORMb, "NAMEb10", "CAPTIONb10", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255) ' AddTabstrip
n = 10
AddMultipage USERFORMb, "NAMEb11", "CAPTIONb11", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)    ' AddMultipage
n = 11
AddScrollbar USERFORMb, "NAMEb12", "CAPTIONb12", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)   ' AddScrollbar
n = 12
AddSpinbutton USERFORMb, "NAMEb13", "CAPTIONb13", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)    ' AddSpinbutton
n = 13
AddImage USERFORMb, "NAMEb14", "CAPTIONb14", Leftb, 25 * n, WIDTHb, , RGB(255, 255,
255)    ' AddImage


VBA.UserForms.Add(USERFORMb.Name).Show
End Sub
```

Appendix E- Streamlining Positioning and Properties

As a final thought, readers are encouraged to explore alternative methodologies for refining the code further; they are invited to experiment with extending form control and UserForm properties, integrating these techniques into the code discussed in this article. These could include utilizing loops for repetitive tasks, employing arrays or collections for managing control attributes, or exploring advanced VBA functionalities to enhance efficiency and maintainability. This exploration can lead to more elegant solutions, potentially reducing code complexity and improving overall performance. We hope this iterative process of learning and application paves the way for innovative solutions.