

ภาคผนวก ค.

ค.1 โปรแกรมการเคลื่อนที่ของหุ่นยนต์

```
Option Explicit
Dim B_Start As Boolean
Dim TargetX(50) As Long
Dim TargetY(50) As Long
Dim TargetN As Long
Dim TargetEnd As Long
Dim RobotX(50) As Double
Dim RobotY(50) As Double
'Dim RobotX2(50) As Double
'Dim RobotY2(50) As Double
Dim Slop As Double
Dim Dx As Double, Dy As Double
Dim StartSTEP As Long
Dim RobotNUM As Long

Private Sub Combo1_Change()
    If Combo1.ListIndex = 0 Then
        Shape1.Visible = True
    ElseIf Combo1.ListIndex = 1 Then
        Shape1.Visible = False
    End If
End Sub

Private Sub Command1_Click()
    If TargetN <> 0 Then
        StartSTEP = 0
        TargetEnd = TargetN
        TargetN = 0
        RobotX(0) = TargetX(TargetN)
        RobotY(0) = TargetY(TargetN)
        RobotNUM = 0
        TargetN = 1
        Dx = TargetX(TargetN) - TargetX(TargetN - 1)
        Dy = TargetY(TargetN) - TargetY(TargetN - 1)
        Slop = SlopWay(Dx, Dy)
        Timer1.Enabled = True
    End If
End Sub

Private Sub Form_Load()
    Combo1.ListIndex = 0
    B_Start = True
    TargetN = 0
```

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With Shape1
    TargetX(TargetN) = .Left + (.Width / 2)
    TargetY(TargetN) = .Top + (.Height / 2)
End With
End Sub

Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single,
Y As Single)
Dim i As Long
    If B_Start = True Then
        Picture1.Cls
        TargetN = 0
        With Shape1
            Timer1.Enabled = False
            TargetX(TargetN) = .Left + (.Width / 2)
            TargetY(TargetN) = .Top + (.Height / 2)
            For i = 0 To 50
                RobotX(i) = TargetX(0)
                RobotY(i) = TargetY(0)
            Next i
        End With
        B_Start = False
    End If
    Picture1.Line (TargetX(TargetN), TargetY(TargetN))-(X, Y), vbRed
    TargetN = TargetN + 1
    TargetX(TargetN) = X
    TargetY(TargetN) = Y
End Sub

Private Function SlopWay(Dx As Double, Dy As Double) As Double
    If Dy >= 0 Then
        If Dx <> 0 Then
            SlopWay = Atn(Dy / Dx)
            If SlopWay < 0 Then SlopWay = 3.14 + SlopWay
        Else
            SlopWay = 1.57
        End If
    Else
        If Dx <> 0 Then
            SlopWay = Atn(Dy / Dx)
            If SlopWay < 0 Then SlopWay = 3.14 + SlopWay
            SlopWay = 3.14 + SlopWay
        Else
            SlopWay = 4.71
        End If
    End If
End Function

Private Sub Timer1_Timer()
    StartSTEP = StartSTEP + 1
    If B_Start = False Then

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Dx = TargetX(TargetN) - TargetX(TargetN - 1)
Dy = TargetY(TargetN) - TargetY(TargetN - 1)
Slop = SlopWay(Dx, Dy)
If Abs(Cos(Slop)) > 0.5 Then
    RobotX(0) = RobotX(0) + Cos(Slop)
    RobotY(0) = (RobotX(0) - TargetX(TargetN)) * (Dy / Dx) +
TargetY(TargetN)
    'Picture1.PSet (RobotX(0), RobotY(0)), vbGreen
    Shape2(0).Top = RobotY(0) - 3
    Shape2(0).Left = RobotX(0) - 3
Else
    RobotY(0) = RobotY(0) + Sin(Slop)
    RobotX(0) = (RobotY(0) - TargetY(TargetN)) * (Dx / Dy) +
TargetX(TargetN)
    'Picture1.PSet (RobotX(0), RobotY(0)), vbGreen
    Shape2(0).Top = RobotY(0) - 3
    Shape2(0).Left = RobotX(0) - 3
End If
If Abs(RobotX(0) - TargetX(TargetN)) < 1 And Abs(RobotY(0) -
TargetY(TargetN)) < 1 Then
    TargetN = TargetN + 1
    If TargetN > TargetEnd Then
        'Timer1.Enabled = False
        B_Start = True
    End If
End If
End If
End If
'


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Dim i As Long
If StartSTEP > Text1.Text And RobotNUM < 50 Then
    StartSTEP = 0
    RobotNUM = RobotNUM + 1
End If
For i = 1 To RobotNUM
    If Abs(RobotX(i) - TargetX(TargetEnd)) < 4 And Abs(RobotY(i) -
TargetY(TargetEnd)) < 4 Then
        RobotX(i) = TargetX(TargetEnd)
        RobotY(i) = TargetY(TargetEnd)
    Else
        Dx = RobotX(i - 1) - RobotX(i)
        Dy = RobotY(i - 1) - RobotY(i)
        Slop = SlopWay(Dx, Dy)
        If Abs(Cos(Slop)) > 0.5 Then
            RobotX(i) = RobotX(i) + Cos(Slop)
            RobotY(i) = (RobotX(i) - RobotX(i - 1)) * (Dy / Dx) + RobotY(i -
1)

            Picture1.PSet (RobotX(i), RobotY(i)), vbRed
            Shape2(i).Top = RobotY(i) - 3
            Shape2(i).Left = RobotX(i) - 3
        Else

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RobotY(i) = RobotY(i) + Sin(Slop)
RobotX(i) = (RobotY(i) - RobotY(i - 1)) * (Dx / Dy) + RobotX(i -
1)

Picture1.PSet (RobotX(i), RobotY(i)), vbRed
Shape2(i).Top = RobotY(i) - 3
Shape2(i).Left = RobotX(i) - 3
End If
End If
Next i
End Sub

```

ค.2 โปรแกรมการเคลื่อนที่ของหุ่นยนต์

VERSION 5.00

Begin VB.Form Form1

Caption = "Form1"

ClientHeight = 6315

ClientLeft = 60

ClientTop = 345

ClientWidth = 8520

LinkTopic = "Form1"

ScaleHeight = 6315

ScaleWidth = 8520

StartPosition = 3 'Windows Default

Begin VB.ComboBox Combo1

Height = 315

ItemData = "Part.frx":0000

Left = 6960

List = "Part.frx":000A

TabIndex = 4

Text = "1"

Top = 1440

Width = 1335

End

Begin VB.CommandButton Command2

Caption = "Command2"

Height = 495

Left = 7200

TabIndex = 3

Top = 2640

Width = 1095

End

Begin VB.Timer Timer1

Enabled = 0 'False

Interval = 10

Left = 480

Top = 5160

End

Begin VB.TextBox Text1

Height = 375

Left = 6960

TabIndex = 2

Text = "30"

Top = 840

Width = 615

End

Begin VB.CommandButton Command1

```

Caption      = "Command1"
Height       = 495
Left         = 6840
TabIndex     = 1
Top          = 120
Width        = 1455
End
Begin VB.PictureBox Picture1
    AutoRedraw   = -1 'True
    FillColor    = &H0000FFFF&
    Height       = 4815
    Left         = 120
    ScaleHeight  = 317
    ScaleMode    = 3 'Pixel
    ScaleWidth   = 437
    TabIndex     = 0
    Top          = 120
    Width        = 6615
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 50
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 49
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 48
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135

```

```

End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 47
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 46
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 45
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 44
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135

```

```

Index      = 43
Left       = 0
Shape      = 3 'Circle
Top        = 0
Width      = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 42
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 41
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 40
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 39
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End

```



```
Begin VB.Shape Shape2
  BorderColor  = &H000000FF&
  FillColor    = &H0000FFFF&
  FillStyle    = 0 'Solid
  Height       = 135
  Index        = 38
  Left         = 0
  Shape        = 3 'Circle
  Top          = 0
  Width        = 135
```

End

```
Begin VB.Shape Shape2
  BorderColor  = &H000000FF&
  FillColor    = &H0000FFFF&
  FillStyle    = 0 'Solid
  Height       = 135
  Index        = 37
  Left         = 0
  Shape        = 3 'Circle
  Top          = 0
  Width        = 135
```

End

```
Begin VB.Shape Shape2
  BorderColor  = &H000000FF&
  FillColor    = &H0000FFFF&
  FillStyle    = 0 'Solid
  Height       = 135
  Index        = 36
  Left         = 0
  Shape        = 3 'Circle
  Top          = 0
  Width        = 135
```

End

```
Begin VB.Shape Shape2
  BorderColor  = &H000000FF&
  FillColor    = &H0000FFFF&
  FillStyle    = 0 'Solid
  Height       = 135
  Index        = 35
  Left         = 0
  Shape        = 3 'Circle
  Top          = 0
  Width        = 135
```

End

```
Begin VB.Shape Shape2
  BorderColor  = &H000000FF&
  FillColor    = &H0000FFFF&
  FillStyle    = 0 'Solid
  Height       = 135
  Index        = 34
```

```

Left      = 0
Shape     = 3 'Circle
Top       = 0
Width     = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 33
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 32
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 31
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 30
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2

```

```

    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 29
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 28
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 27
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 26
    Left         = 0
    Shape        = 3 'Circle
    Top          = 0
    Width        = 135
End
Begin VB.Shape Shape2
    BorderColor  = &H000000FF&
    FillColor    = &H0000FFFF&
    FillStyle    = 0 'Solid
    Height       = 135
    Index        = 25
    Left         = 0

```

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    Shape      = 3 'Circle
    Top        = 0
    Width      = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 24
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 23
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 22
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 21
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&

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```

FillColor    = &H0000FFFF&
FillStyle    = 0 'Solid
Height       = 135
Index        = 20
Left         = 0
Shape        = 3 'Circle
Top          = 0
Width        = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 19
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 18
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 17
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 16
    Left        = 0
    Shape       = 3 'Circle

```

```

Top      = 0
Width    = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 15
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 14
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 13
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 12
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&

```

```

FillStyle    = 0 'Solid
Height       = 135
Index        = 11
Left         = 0
Shape        = 3 'Circle
Top          = 0
Width        = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 10
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 9
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 8
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0
    Width       = 135
End
Begin VB.Shape Shape2
    BorderColor = &H000000FF&
    FillColor   = &H0000FFFF&
    FillStyle   = 0 'Solid
    Height      = 135
    Index       = 7
    Left        = 0
    Shape       = 3 'Circle
    Top         = 0

```

```

Width      = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 6
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 5
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 4
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid
  Height      = 135
  Index       = 3
  Left        = 0
  Shape       = 3 'Circle
  Top         = 0
  Width       = 135
End
Begin VB.Shape Shape2
  BorderColor = &H000000FF&
  FillColor   = &H0000FFFF&
  FillStyle   = 0 'Solid

```



```

        Height      = 135
        Index       = 2
        Left        = 0
        Shape       = 3 'Circle
        Top         = 0
        Width       = 135
    End
Begin VB.Shape Shape2
    BorderColor    = &H000000FF&
    FillColor      = &H0000FFFF&
    FillStyle      = 0 'Solid
    Height        = 135
    Index         = 1
    Left          = 0
    Shape         = 3 'Circle
    Top           = 0
    Width         = 135
End
Begin VB.Shape Shape2
    BorderColor    = &H000000FF&
    FillColor      = &H0000FFFF&
    FillStyle      = 0 'Solid
    Height        = 135
    Index         = 0
    Left          = 0
    Shape         = 3 'Circle
    Top           = 0
    Width         = 135
End
Begin VB.Shape Shape1
    BackColor      = &H000000FF&
    FillColor      = &H00FF0000&
    Height        = 495
    Left          = 1440
    Shape         = 2 'Oval
    Top           = 2160
    Width         = 495
End
End
End
Attribute VB_Name = "Form1"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
Option Explicit
Dim B_Start As Boolean
Dim TargetX(50) As Long
Dim TargetY(50) As Long
Dim TargetN As Long

```

```

Dim TargetEnd As Long
Dim RobotX(50) As Double
Dim RobotY(50) As Double
'Dim RobotX2(50) As Double
'Dim RobotY2(50) As Double
Dim Slop As Double
Dim Dx As Double, Dy As Double
Dim StartSTEP As Long
Dim RobotNUM As Long

```

```

Private Sub Combo1_Change()
    If Combo1.ListIndex = 0 Then
        Shape1.Visible = True
    ElseIf Combo1.ListIndex = 1 Then
        Shape1.Visible = False
    End If
End Sub

```

```

Private Sub Command1_Click()
    If TargetN <> 0 Then
        StartSTEP = 0
        TargetEnd = TargetN
        TargetN = 0
        RobotX(0) = TargetX(TargetN)
        RobotY(0) = TargetY(TargetN)
        RobotNUM = 0
        TargetN = 1
        Dx = TargetX(TargetN) - TargetX(TargetN - 1)
        Dy = TargetY(TargetN) - TargetY(TargetN - 1)
        Slop = SlopWay(Dx, Dy)
        Timer1.Enabled = True
    End If
End Sub

```

```

Private Sub Form_Load()
    Combo1.ListIndex = 0
    B_Start = True
    TargetN = 0
    With Shape1
        TargetX(TargetN) = .Left + (.Width / 2)
        TargetY(TargetN) = .Top + (.Height / 2)
    End With
End Sub

```

```

Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single,
Y As Single)
    Dim i As Long
    If B_Start = True Then
        Picture1.Cls
        TargetN = 0
    End If
End Sub

```

```

With Shape1
    Timer1.Enabled = False
    TargetX(TargetN) = .Left + (.Width / 2)
    TargetY(TargetN) = .Top + (.Height / 2)
    For i = 0 To 50
        RobotX(i) = TargetX(0)
        RobotY(i) = TargetY(0)
    Next i
End With
B_Start = False
End If
Picture1.Line (TargetX(TargetN), TargetY(TargetN))-(X, Y), vbRed
TargetN = TargetN + 1
TargetX(TargetN) = X
TargetY(TargetN) = Y
End Sub

Private Function SlopWay(Dx As Double, Dy As Double) As Double
    If Dy >= 0 Then
        If Dx <> 0 Then
            SlopWay = Atn(Dy / Dx)
            If SlopWay < 0 Then SlopWay = 3.14 + SlopWay
        Else
            SlopWay = 1.57
        End If
    Else
        If Dx <> 0 Then
            SlopWay = Atn(Dy / Dx)
            If SlopWay < 0 Then SlopWay = 3.14 + SlopWay
            SlopWay = 3.14 + SlopWay
        Else
            SlopWay = 4.71
        End If
    End If
End Function

Private Sub Timer1_Timer()
    StartSTEP = StartSTEP + 1
    If B_Start = False Then
        Dx = TargetX(TargetN) - TargetX(TargetN - 1)
        Dy = TargetY(TargetN) - TargetY(TargetN - 1)
        Slop = SlopWay(Dx, Dy)
        If Abs(Cos(Slop)) > 0.5 Then
            RobotX(0) = RobotX(0) + Cos(Slop)
            RobotY(0) = (RobotX(0) - TargetX(TargetN)) * (Dy / Dx) +
TargetY(TargetN)
            Picture1.PSet (RobotX(0), RobotY(0)), vbGreen
            Shape2(0).Top = RobotY(0) - 3
            Shape2(0).Left = RobotX(0) - 3
        Else
            RobotY(0) = RobotY(0) + Sin(Slop)

```

```

        RobotX(0) = (RobotY(0) - TargetY(TargetN)) * (Dx / Dy) +
TargetX(TargetN)
        'Picture1.PSet (RobotX(0), RobotY(0)), vbGreen
        Shape2(0).Top = RobotY(0) - 3
        Shape2(0).Left = RobotX(0) - 3
    End If
    If Abs(RobotX(0) - TargetX(TargetN)) < 1 And Abs(RobotY(0) -
TargetY(TargetN)) < 1 Then
        TargetN = TargetN + 1
        If TargetN > TargetEnd Then
            'Timer1.Enabled = False
            B_Start = True
        End If
    End If
End If
'
Dim i As Long
If StartSTEP > Text1.Text And RobotNUM < 50 Then
    StartSTEP = 0
    RobotNUM = RobotNUM + 1
End If
For i = 1 To RobotNUM
    If Abs(RobotX(i) - TargetX(TargetEnd)) < 4 And Abs(RobotY(i) -
TargetY(TargetEnd)) < 4 Then
        RobotX(i) = TargetX(TargetEnd)
        RobotY(i) = TargetY(TargetEnd)
    Else
        Dx = RobotX(i - 1) - RobotX(i)
        Dy = RobotY(i - 1) - RobotY(i)
        Slop = SlopWay(Dx, Dy)
        If Abs(Cos(Slop)) > 0.5 Then
            RobotX(i) = RobotX(i) + Cos(Slop)
            RobotY(i) = (RobotX(i) - RobotX(i - 1)) * (Dy / Dx) + RobotY(i -
1)
            Picture1.PSet (RobotX(i), RobotY(i)), vbRed
            Shape2(i).Top = RobotY(i) - 3
            Shape2(i).Left = RobotX(i) - 3
        Else
            RobotY(i) = RobotY(i) + Sin(Slop)
            RobotX(i) = (RobotY(i) - RobotY(i - 1)) * (Dx / Dy) + RobotX(i -
1)
            Picture1.PSet (RobotX(i), RobotY(i)), vbRed
            Shape2(i).Top = RobotY(i) - 3
            Shape2(i).Left = RobotX(i) - 3
        End If
    End If
End If
Next i
End Sub

```

9.3 Psuedocode

```
1 procedure ACO_Meta_heuristic()
2   while (termination_criterion_not_satisfied)
3     schedule_activities
4       ants_generation_and_activity();
5       pheromone_evaporation();
6       daemon_actions(); {optional}
7     end schedule_activities
8   end while
9 end procedure

10 procedure ants_generation_and_activity()
11   while(available_resources)
12     schedule_the_creation_of_a_new_ant();
13     new_active_ant();
14   end while
15 end procedure

16 procedure new_active_ant() {ant lifecycle}
17   initialize_ant();
18   M = update_ant_memory();
19   while(current_state  $\neq$  target_state)
20     A = read_local_ant_routing_table();
21     P = compute_transition_probabilities(A,M,problem_constraints);
22     next_state = apply_ant_decision_policy(P,problem_constraints);
23     move_to_next_state(next_state);
24     if(online_step_by_step_pheromone_update)
25       deposit_pheromone_on_the_visited_arc();
26       update_ant_routing_table();
```

```
27     end if
28     M = update_internal_state();
29     end while
30     if(online_delayed_pheromone_update)
31         evaluate_solution();
32         evaluate_pheromone_on_all_visited_arcs();
33         update_ant_routing_table();
34     end if
35     die();
36 end procedure
```