Chapter – 4

Prototype Development of Fractal Base Clustering Model to provide an Effective Customer Relationship Management System & Result Discussion

4.1 Clustering Model to extract plotted data in the form of table by taking a Rectangle as graphical selector.

Initially researcher design & develop a model to extract the plotted data in the form of some table by taking a Rectangle shape as graphical selector to create a cluster. Thus following model was designed and prototype was developed by researcher to fulfill above specified requirements.

4.1.1 Components of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.

(a) Rect_Cluster

It is a main component of the model on which all the other components like plotting area, graphical selector, Data Populator, Data Grid, Total Sales and Average Sales are placed.

(b) Cluster Database:

Figure 4.1 Rect_Cluster, the main component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created cluster table from which records are fetched and displayed on the Plotting area. Also all the records selected by graphical selector are first compared with the field lx and ly of cluster table and then stored into the data grid. Cluster database and Cluster table are define in detail in section 3.1.2, thus these components are not define again here.

(c) Plotting area:
Plotting area is the component of the model that is used to display all the records of the cluster table on the screen. Records are displayed on plotting area at specific top-left values where top is dependent on ly field value and left is dependent on lx field value of the cluster table.

![Figure 4.2 Plotting area, the component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.](image)

(d) Graphical Selector

![Figure 4.3 Graphical Selector, the component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.](image)
Graphical Selector is the component of the model that is used to select records from the plotted area. Researcher has provided the rectangle shape as graphical selector tool. End-user has to click on the plotting area where he/she wants to create cluster. Here rectangle shape will appear once user click left mouse button and it will move with the fixed starting point in the direction of mouse pointer and its size will be also increased and decreased in the direction of the mouse pointer and this movement will be continue until and unless end-user releases the left mouse button.

(e) **Data Populator**

Data Populator is the component of the model that performs the process to display records on the plotting area. When user clicks on this component, it starts the process of fetching records from the table and displays the records on the plotting area.

Figure 4.4 Data Populator, the component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

(f) **Data Grid**

DataGrid is the component of the model that is responsible to store & display the records selected by graphical selector. When user completes the process of selecting records with graphical selector and when user releases the mouse, immediately the process of storing and displaying starts in the data grid and it is populated with the selected records.

Figure 4.5 Data Grid, the component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

(g) **Total Sales**

This component is used to display total sales which is taken place for the all records selected within the bound of rectangle a graphical selector.

Figure 4.6 Total Sales, the component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector
(h) Average Sales Labels

This component is used to display average sales which is taken place for the all records selected within the bound of rectangle a graphical selector.

![Average Sales](image)

Figure 4.7 Average Sales, the component of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

4.1.2 Development of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [1,3,5,7].

```
‘Declaration of global variable and declaration of connection object and recordset object to be used’
Option Explicit
Dim sx, sy, ex, ey As Long
Dim cn As ADODB.Connection
Dim rs1 As ADODB.Recordset
‘An event executed when user starts the execution of the program and also used to open connection-recordset as well as to define the datagrid and shape’
Private Sub Form_Load()
sp.Shape = 0
Set cn = New ADODB.Connection
    cn.Open  "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
Set rs1 = New Recordset
    rs1.Open "cluster", cn, adOpenDynamic, adLockBatchOptimistic, adCmdTable
    msf1.Cols = 4
    msf1.Rows = 1
    msf1.ColWidth(0) = 1500
End Sub

‘Command button defined as Data Populator, when clicked fetches the data from database and displays the data on plotting area.
Private Sub Command1_Click()
Picture1.Cls
    rs1.MoveFirst
    Picture1.ForeColor = vbRed
    While (rs1.EOF <> True)
        Picture1.PSet (rs1.Fields(1).Value, rs1.Fields(2)), vbRed
        Picture1.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2)), vbMagenta
        Picture1.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2)), vbMagenta
        Picture1.PSet (rs1.Fields(1).Value, rs1.Fields(2) + 1), vbMagenta
        Picture1.PSet (rs1.Fields(1).Value, rs1.Fields(2) - 1), vbMagenta
End While
```

Picture1.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2) + 1), vbMagenta
Picture1.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2) + 1), vbMagenta
Picture1.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2) - 1), vbMagenta
Picture1.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2) - 1), vbMagenta
Picture1.ForeColor = vbMagenta
Picture1.Print rs1.Fields(0).Value
rs1.MoveNext
Wend
    Picture1.ForeColor = vbBlue
End Sub

'An event executed when user clicks left mouse button and starts drawing a rectangle shape cluster'
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
    sp.Top = X
    sp.Left = Y
    sp.Visible = True
    sx = X
    sy = Y
End Sub

'An event executed when moves mouse pointer on the plotting area to increase decrease the size of graphical selector in form of rectangle shape'
Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
On Error Resume Next
If Button = vbLeftButton Then
    sp.Visible = True
    If X > sx And Y > sy Then
        sp.Left = sx
        sp.Top = sy
        sp.Width = ex - sx
        sp.Height = ey - sy
    End If
    If X < sx And Y > sy Then
        sp.Left = X
        sp.Top = sy
        sp.Width = sx - ex
        sp.Height = ey - sy
    End If
    If X > sx And Y < sy Then
        sp.Left = sx
        sp.Top = Y
        sp.Width = ex - sx
        sp.Height = sy - ey
    End If
    If X < sx And Y < sy Then
        sp.Left = X
        sp.Top = Y
        sp.Width = sx - ex
        sp.Height = sy - ey
    End If
End If
End If
ex = X
ey = Y
End If
End Sub

‘An event executed when user releases the mouse button it start the fetching of
data from the database according to the records selected on the plotting area and
fill the data grid with this selected records’

Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
Dim ts As Currency
Dim t As Long
ex = X
ey = Y
If sx > ex Then
    t = sx
    sx = ex
    ex = t
End If
If sy > ey Then
    t = sy
    sy = ey
    ey = t
End If
ts = 0
msf1.Clear
msf1.Rows = 1
Dim k As Integer
For k = 0 To 3
    msf1.TextMatrix(0, k) = rs1.Fields(k).Name
Next k
k = 1
rs1.MoveFirst
While (rs1.EOF <> True)
    If (rs1.Fields(1).Value >= sx And rs1.Fields(2) >= sy) Then
        If (rs1.Fields(1) <= ex And rs1.Fields(2) <= ey) Then
            msf1.Rows = msf1.Rows + 1
            msf1.TextMatrix(k, 0) = rs1.Fields(0).Value
            msf1.TextMatrix(k, 1) = rs1.Fields(1).Value
            msf1.TextMatrix(k, 2) = rs1.Fields(2).Value
            msf1.TextMatrix(k, 3) = rs1.Fields(3).Value
            ts = ts + rs1.Fields(3).Value
            k = k + 1
        End If
    End If
    rs1.MoveNext
Wend
If k > 1 Then
    l1.Caption = ts
    l2.Caption = ts / (k - 1)
End If
End Sub

4.1.3 Steps to implement the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) **When researcher starts the execution of the program following screen appears first.**

![First step of implementation of the Clustering Model](image)

Figure 4.8 First step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on plotting area.

(b) **When Data Populator is clicked**

When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the plotting area. The top-left values are corresponding values of the lx and ly field of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on plotting area.
Figure 4.9 Second step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

(c) When user clicks on plotting area and move mouse pointer

Figure 4.10 Third step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

When user clicks on plotting area, the rectangle shape graphical selector appears on the plotting area and its size can be increased or decreased as per the users requirement to select desired records. User can cluster the desired records by selecting it with customized rectangle shape cluster.
(d) When user release the mouse button

When user releases the mouse the rectangle shape cluster is created and the cluster that was sizable earlier becomes fix on the plotting area. All the records bounded within the rectangle shape cluster are becomes set of selected records and appears on the data grid area.

Figure 4.11 Fourth step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector

Enlarged view of plotting area & graphical selector (Figure 4.12) and data grid (Figure 4.13) are described below which clearly states that those records selected by the user with the rectangle graphical selectors appears in the data grid.
Also total sales and average sales are also calculated for the sales amount of those customers whose records are selected through the graphical selector from the plotting area.

### 4.1.4 Key Features of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.

- The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.
- With utmost flexibility user can draw and define a cluster of rectangle shape that can cover or bound 100% desired records with the clustering. Here Rectangle shape of the cluster can be increased to cover more area or to include more records and can be decreased as per the end-user conveniences.
- Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.
End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales already given with the model as selected records are easily accessible from the data grid.

4.1.5 Limitations of the Clustering Model to extract plotted data in the form of table by taking a Rectangle graphical selector.

- Model application only allows to form the cluster in the rectangle shape only that reduces the flexibility and accuracy of the end user in terms of selection of records.
- Once user has decided the area to be clustered and when he/she clicks on the plotting area, that point becomes fixed starting point of the rectangle shape cluster. Of course user can increase/ decrease the size of cluster but cannot move cluster on other position
- If requirement of creating cluster in circular shape or fractal shape then this model may not be useful. For example if data to be cluster is with some central point and within specific radius or fractal shape of cluster is to be formed

After analyzing above define limitation researcher decided to design & develop another model that can provide better way of selection of records and cluster to be created should be sizable as well as movable. Thus researcher design & develop a new Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector.

4.2 Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector.

To provide clustering process in circular way Researcher design & develop a model to extract the plotted data in the form of some table by taking a Circle shape as graphical selector to create a cluster. Thus following model was designed and prototype was developed by researcher to fulfill requirements specified above in section 4.1.

4.2.1 Components of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector.

(a) Circular_Cluster
It is a main component of the model on which all the other components like plotting area, graphical selector, Data Populator, Data Grid, Total Sales and Average Sales are placed.

(b) Cluster Database:
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created cluster table from which records are fetched and displayed on the Plotting area. Also all the records selected by graphical selector are first compared with the field lx and ly of cluster table and then stored into the data grid. The structure of the Cluster database and cluster table as well a recordset are same as define with table 4.2.2. Thus these components are not defined in detail.

(c) Plotting area:
The design and the functionality of this component is as same as the component of model 4.1.1 (c) Plotting area. Thus it is not redefine over here.

(d) Graphical Selector
Graphical Selector is the component of the model that is used to select records from the plotted area. Researcher has provided the Circle shape as graphical selector tool. End-user has to click on the plotting area where he/she wants to create cluster. Here Circular shape will appear once user click left mouse button and it will move in the direction of mouse pointer. Its size can be also increased by clicking right mouse button. This movement will be continued until and unless end-user double click the left mouse button.

Figure 4.15 Graphical Selector, the component of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector.

(e) Data Populator
The design and the functionality of this component is as same as the component of model 4.1.1 (e) Data Populator. Thus it is not redefine over here.

(f) Data Grid
The design and the functionality of this component is as same as the component of model 4.1.1 (f) Data Grid. Thus it is not redefine over here.

(g) Total Sales
The design and the functionality of this component is as same as the component of model 4.1.1 (g) Total Sales. Thus it is not redefine over here.
(h) Average Sales

The design and the functionality of this component is as same as the component of model 4.1.1 (h) Average Sales. Thus it is not redefine over here.

4.2.2 Development of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector.

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [1,3,5,7].

‘Declaration of global variable and declaration of connection object and recordset object to be used’

Option Explicit

Dim sx, sy, tx, ty As Long
Dim maxx, maxy, minx, miny As Long
Dim cx, cy As Long
Dim i, j, k As Long
Dim t As Integer
Dim cn1 As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim TS As Double
Dim op As Integer
Dim rd As Integer

‘An event executed when user starts the execution of the program and also used to open connection-recordset as well as to define the datagrid and shape’

Private Sub Form_Load()
    t = 0
    op = 1
    rd = 100
    Picture2.ForeColor = vbBlue
    msf1.Rows = 1
    msf1.Cols = 4
    Set cn1 = New ADODB.Connection
    cn1.CursorLocation = adUseClient
    cn1.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
    Set rs1 = New Recordset
    rs1.Open "cluster", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdTable
End Sub

‘An event executed when user starts the execution of the program and wants to repaint the screen’

Private Sub Form_Activate()
    MousePointer = 11
Private Sub Command1_Click()
    Picture2.Cls
    rs1.MoveFirst
    Picture2.ForeColor = vbRed
    While rs1.EOF <> True
        Picture2.PSet (rs1.Fields(1).Value, rs1.Fields(2)), vbRed
        Picture2.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2)), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2)), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value, rs1.Fields(2) + 1), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value, rs1.Fields(2) - 1), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2) + 1), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2) + 1), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2) - 1), vbMagenta
        Picture2.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2) - 1), vbMagenta
        Picture2.ForeColor = vbMagenta
        Picture2.Print rs1.Fields(0).Value
        rs1.MoveNext
    Wend
    Picture2.ForeColor = vbBlue
    Call pictrefresh
End Sub

Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
    If Button = 1 Then
        minx = X - rd
        miny = Y - rd
        maxx = X + rd
        maxy = Y + rd
        cx = X
        cy = Y
        Picture1.ForeColor = vbBlue
        Picture1.Circle (cx, cy), rd
        t = 1
    End If
    If Button = 2 Then
        rd = rd * 1.1
    End If
End Sub
An event executed when user moves mouse pointer on the plotting area to move graphical selector that is form of circular shape

Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
    minx = X - rd
    miny = Y - rd
    maxx = X + rd
    maxy = Y + rd
    cx = X
    cy = Y
    If t = 1 Then
        Call pictrefresh
        Picture1.Circle (cx, cy), rd
    End If
End Sub

An event executed when user double clicks left mouse button and it initiates the process of fetching of data from the database according to the records selected on the plotting area and fill the data grid with this selected records

Private Sub Picture1_DblClick()
    t = 0
    TS = 0
    Picture1.Enabled = False
    Dim flg As Integer
    Dim i1, j1 As Long
    i1 = 640
    j1 = 640
    For k = 0 To 3
        msf1.TextMatrix(0, k) = rs1.Fields(k).Name
    Next k
    msf1.ColWidth(0) = 1500
    k = 1
    MsgBox ("Please Wait While Result Is Generated")
    For j = miny To maxy
        flg = 0
        For i = minx To maxx
            If Picture1.Point(i, j) = vbBlue Then
                If (j = j1 And i = i1 + 1) = False Then
                    flg = flg + 1
                End If
                i1 = i
                j1 = j
            End If
            If Picture2.Point(i, j) = vbRed Then
                If flg Mod 2 = 1 Then
                    rs1.MoveFirst
                    While rs1.EOF <> True
                        If rs1.Fields(1).Value = i And rs1.Fields(2).Value = j Then
                            msf1.Rows = msf1.Rows + 1
                            msf1.TextMatrix(k, 0) = rs1.Fields(0).Value
                        End If
                    Wend
                End If
            End If
        Next i
    Next j
End Sub
msf1.TextMatrix(k, 1) = rs1.Fields(1).Value
msf1.TextMatrix(k, 2) = rs1.Fields(2).Value
msf1.TextMatrix(k, 3) = rs1.Fields(3).Value
TS = TS + rs1.Fields(3).Value
k = k + 1
End If
rs1.MoveNext
Wend
End If
End If
Next i
Next j
l1.Caption = TS
l2.Caption = TS / (k - 1)
End Sub

'The function which is called by various events like mouse_down, mouse_up, mouse_move to repaint the picture every time when user moves the graphical selector, increases the size of graphical selector
Private Sub pictrefresh()
    MousePointer = 11
    Picture1.PaintPicture Picture2.Image, 0, 0, Picture1.Width, Picture1.Height,
Picture1.Left, Picture1.Top, Picture1.Width, Picture1.Height
    'Picture1.Line (1, 1)-(Picture1.Width - 1, Picture1.Height - 1), , B
    MousePointer = 0
End Sub

4.2.2 Steps to implement the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector & Result Discussion.
To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.
When researcher executes the program the above define layout appears on the screen.
All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on plotting area.
Figure 4.16 First step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector

(b) When Data Populator is clicked

Figure 4.17 Second step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector

When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the plotting area. The top-left values are corresponding values of the lx and ly field of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on plotting area.

(c) When user clicks on plotting area and move mouse pointer
When user clicks on plotting area, the circular shape graphical selector appears on the plotting area and its size can be increased or decreased as per the users requirement to select desired records. Also user can move this graphical selector to select desired record without the bound of fixed starting point. User can cluster the desired records by selecting it with customized circular shape cluster.

Figure 4.18 Third step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector

(d) When user right clicks on plotting area and moves mouse pointer (optional)

When researcher clicks the right mouse button on the plotting the size of the circle shape cluster increases by 10% and when researcher moves mouse pointer across the plotting area circle shape cluster moves also in the direction of mouse pointer. Both actions are optional and they are executed only if user wants to do so
Figure 4.19 Fourth step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector

(e) When Researcher double click left the mouse button

Figure 4.20 Fifth step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector

When researcher double clicks the mouse button the circular shape cluster is created and the cluster that was sizable & movable earlier becomes fix on the plotting area. All the records bounded within the circular shape cluster are becomes set of selected records and appears on the data grid area. Enlarged view of Circle shape graphical selector and data grid are displayed below.
4.2.3 Key Features of the Clustering Model to extract plotted data in the form of table by taking Circle as graphical selector.

- The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.
- End user gets the flexibility of moving the circular cluster shape across the plotting area as well as the Circle shape of the cluster can be increased to
select desired records as per the end-user conveniences. Thus this model removes the limitation of previous model of moving cluster according to the requirement without fixing starting point of the cluster.

- Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

- End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales already given with the model as selected records are easily accessible from the data.

4.2.4 Limitations of the Clustering Model to extract plotted data in the form of table by taking a Circle as graphical selector.

- Model application only allow to form the cluster in Circular shape only that reduces the flexibility and accuracy of the end user in terms of selection of records.

- If requirement of creating cluster in fractal shape then this model may not be useful as it provides the flexibility of creating cluster only in circular shape.

After analyzing above define limitation researcher decided to design & develop another model that can provide maximum flexibility in terms of shape of the cluster. Thus researcher design & develop a new Clustering Model to extract plotted data in the form of table by taking a closed fractal shape as graphical selector.

4.3 Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector.

To provide clustering operations with maximum flexibility in terms of cluster shape and records to be selected, Researcher design & develop a model to extract the plotted data in the form of some table by taking a Fractal shape as graphical selector to create a cluster. Thus following model was designed and prototype was developed by researcher to fulfill requirements specified above in section 4.1.

4.3.1 Components of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector.
(a) Fractal_Cluster
It is a main component of the model on which all the other components like plotting area, graphical selector, Data Populator, Data Grid, Total Sales and Average Sales are placed.

![Fractal_Cluster Diagram](image)

Figure 4.23 Fractal_Cluster, the main component of the Clustering Model to extract plotted data in the form of table by taking a Fractal graphical selector.

(b) Cluster Database:
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created cluster table from which records are fetched and displayed on the Plotting area. Also all the records selected by graphical selector are first compared with the field lx and ly of cluster table and then stored into the data grid. The structure of the Cluster database and cluster table as well a recordset are same as define with table 4.2.2. Thus these components are not defined in detail.

(c) Plotting area:
The design and the functionality of this component is as same as the component of model 4.1.1 (c) Plotting area. Thus it is not redefine over here.

(d) Graphical Selector
Graphical Selector is the component of the model that is used to select records from the plotted area. Researcher has provided the way where user can create a fractal
shape cluster, For this End-user has to click on the plotting area where he/she wants to create cluster. The Fractal shape cluster will be drawn as user moves mouse pointer to select and bound records within the plotting area. Once user release the left mouse button a line will be automatically drawn between the starting point and the ending points of the cluster. This will create the fractal shape and all the desired records will be bounded by this closed fractal shape.

Figure 4.24 Graphical Selector, the component of the Clustering Model to extract plotted data in the form of table by taking a Fractal shape as graphical selector.

(e) Data Populator
The design and the functionality of this component is as same as the component of model 4.1.1 (e) Data Populator. Thus it is not redefine over here.

(f) Data Grid
The design and the functionality of this component is as same as the component of model 4.1.1 (f) Data Grid. Thus it is not redefine over here.

(g) Total Sales
The design and the functionality of this component is as same as the component of model 4.1.1 (g) Total Sales. Thus it is not redefine over here.

(h) Average Sales Labels
The design and the functionality of this component is as same as the component of model 4.1.1 (h) Average Sales. Thus it is not redefine over here.
4.3.2 Development of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector.

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [2,3,4,8].

‘Declaration of global variable and declaration of connection object and recordset object to be used’

Option Explicit
Dim sx, sy, tx, ty As Long
Dim maxx, maxy, minx, miny As Long
Dim i, j, k As Long
Dim t As Integer
Dim cn1 As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim TS As Double

‘An event executed when user starts the execution of the program and also used to open connection-recordset as well as to define the datagrid and shape’
Private Sub Form_Load()
    t = 0
    Picture1.ForeColor = vbBlue
    msf1.Rows = 1
    msf1.Cols = 4
    Set cn1 = New ADODB.Connection
    cn1.CursorLocation = adUseClient
    cn1.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
    Set rs1 = New Recordset
    rs1.Open "cluster", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdTable
    msf1.ColWidth(0) = 1500
    For k = 0 To 3
        msf1.TextMatrix(0, k) = rs1.Fields(k).Name
    Next k
End Sub

‘Command button defined as Data Populator, when clicked fetches the data from database and displays the data on plotting area.’
Private Sub Command1_Click()
    Picture1.Cls
    rs1.MoveFirst
    Picture1.ForeColor = vbRed
    While (rs1.EOF <> True)
        Picture1.PSet (rs1.Fields(1).Value, rs1.Fields(2)), vbRed
        Picture1.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2)), vbMagenta
        Picture1.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2)), vbMagenta
        Picture1.PSet (rs1.Fields(1).Value, rs1.Fields(2) + 1), vbMagenta
        Picture1.PSet (rs1.Fields(1).Value, rs1.Fields(2) - 1), vbMagenta
    Wend
End Sub
Picture1.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2) + 1), vbMagenta
Picture1.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2) + 1), vbMagenta
Picture1.PSet (rs1.Fields(1).Value - 1, rs1.Fields(2) - 1), vbMagenta
Picture1.PSet (rs1.Fields(1).Value + 1, rs1.Fields(2) - 1), vbMagenta
Picture1.ForeColor = vbMagenta
Picture1.Print rs1.Fields(0).Value
rs1.MoveNext
Wend
Picture1.ForeColor = vbBlue
End Sub

‘An event executed when user clicks left mouse button and starts drawing a fractal shape cluster’
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
sx = X
sy = Y
tx = X
ty = Y
minx = X
miny = Y
maxx = X
maxy = Y
t = 1
End Sub

‘An event executed when user moves mouse pointer on the plotting area to define and draw fractal shape with graphical selector.’
Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
If t = 1 Then
   If minx > X Then
      minx = X
   End If
   If miny > Y Then
      miny = Y
   End If
   If maxx < X Then
      maxx = X
   End If
   If maxy < Y Then
      maxy = Y
   End If
   Picture1.Line (tx, ty)-(X, Y)
tx = X
ty = Y
End If
End Sub

‘An event executed when user releases the mouse button it start the fetching of data from the database according to the records selected on the plotting area and fill the data grid with this selected records’
Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
    t = 0
    k = 1
    TS = 0
    Picture1.Enabled = False
    Dim flg As Integer
    Dim i1, j1 As Long
    i1 = 1000
    j1 = 1000
    Picture1.Line (X, Y)-(sx, sy)
    MsgBox ("Please Wait While Result Is Generated")
    For j = miny To maxy
        flg = 0
        For i = minx To maxx
            If Picture1.Point(i, j) = vbBlue Then
                If (j = j1 And i = i1 + 1) = False Then
                    flg = flg + 1
                End If
                i1 = i
                j1 = j
            End If
            If Picture1.Point(i, j) = vbRed Then
                If flg Mod 2 = 1 Then
                    rs1.MoveFirst
                    While rs1.EOF <> True
                        If rs1.Fields(1).Value = i And rs1.Fields(2).Value = j Then
                            msf1.Rows = msf1.Rows + 1
                            msf1.TextMatrix(k, 0) = rs1.Fields(0).Value
                            msf1.TextMatrix(k, 1) = rs1.Fields(1).Value
                            msf1.TextMatrix(k, 2) = rs1.Fields(2).Value
                            msf1.TextMatrix(k, 3) = rs1.Fields(3).Value
                            TS = TS + rs1.Fields(3).Value
                            k = k + 1
                        End If
                    rs1.MoveNext
                    Wend
                End If
            End If
        Next i
    Next j
    l1.Caption = TS
    l2.Caption = TS / (k - 1)
    End Sub

4.2.3 Steps to implement the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector & Result Discussion.
To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) **When researcher starts the execution of the program following screen appears first.**

When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on plotting area.

![Figure 4.25 First step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector](image)

(b) **When Data Populator is clicked**

When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the plotting area. The top-left values are corresponding values of the lx and ly field of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on plotting area.
Figure 4.26 Second step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector

(c) When user clicks on plotting area and moves mouse pointer

Once user clicks on plotting area, he/she is allowed to draw or define fractal shape cluster. For such user has to click somewhere on plotting area near to one of the records he/she wants to bound within cluster and then wherever user move mouse pointer fractal shape will be drawn accordingly. Thus user has to move mouse pointer in such a way so that his/her desired records can be selected within the bound of fractal cluster. Figures 4.27 and figure 4.28 shows that wherever user moves mouse pointer, fractal shape is drawn accordingly. Thus user can create the cluster of any shape and that gives the maximum flexibility to user to select all the desired records within the bound of fractal cluster. Only care has to be taken by end user is that he/she has to draw a fractal in such a way so that all the desired records comes within the fractal shape and starting point of the cluster and the ending point at which user is going to release the mouse button must be nearer so that user can get the 100% perfection in terms of selection of records. For example if user want to cluster records with customer_no= \{11,12,17,18,19,20,23,24,25,26,30,31,32,3,34,38,40\} and if user release the mouse at end point as define in figure 4.27 then customer_no 12,27 may not be cluster or bound within the fractal shape cluster as there will be a line automatically drawn from ending point to the starting point. Instead of that if user draw a fractal like defined in figure 4.28 then all the desired records will be bound and selected within the closed fractal shape cluster.
(d) When user release the mouse button

When user releases the mouse button immediately a line is drawn between the starting point and ending point of cluster and thus forming close end cluster. All the records bounded within the fractal shape cluster becomes set of selected records and appears on the data grid area.
Figure 4.29 Fifth step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector.

Enlarged view of plotting area & graphical selector (Figure 4.30) and data grid (Figure 4.31) are described below which clearly states that those records selected by the user with the fractal shape graphical selectors appears in the data grid. Also total sales and average sales are also calculated for the sales amount of those customers whose records are selected through the graphical selector from the plotting area.

Figure 4.30 Enlarged view of plotting area and graphical selector of figure 4.29
4.3.3 Key Features of the Clustering Model to extract plotted data in the form of table by taking Fractal as graphical selector.

- The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.

- Unlike previous models it is not compulsory to have rectangle shape or circular shape for clustering. With utmost flexibility user can draw a cluster that covers or bound 100% desired records with the fractal shape. Thus end user is getting the flexibility of drawing any shape of cluster as model allows to form the cluster as user moves mouse pointer on the plotting area. Thus not restricted with circular, rectangle or any other shape and thus removes the limitation of previous models. User can define a cluster in a way so that 100% of desired records can be bounded or can be selected to be clustered.

- Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the
data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

- End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales already given with the model as selected records are easily accessible from the data.

4.3.4 Limitations of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector.

- If plotting area is clumsy with the records then it becomes very difficult to select desire records and distinguish the records to be clustered and records not to be clustered.
- Also if plotting area is heavily populated by the records and becomes clumsy then accuracy in terms of selection of desired records degraded as it becomes very difficult for the end user to draw a fractal shape cluster to select records.
- If facility of enlarging plotting area is provided then it creates another problem where most of the enlarged plotting area may not be visible and there is no facility to move the plotting area is provided and thus may not be possible to select desired records

After analyzing above define limitation researcher decided to design & develop another model that can provide maximum flexibility in terms of shape of the cluster. As well as researcher decided to design & develop a new Clustering Model that provides the facility of enlargement of plotting area to select the records and the facility to navigate the plotting area within the navigation area. Thus researcher design and develop a model to extract plotted data in the form of table by taking a closed fractal shape as graphical selector and with zoom-in zoom-out facility to perfectly select records in case of clumsy data as well as with navigation of plotting area.

4.4 Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

To provide clustering operations with maximum flexibility in terms of cluster shape and records to be selected, To provide the better & perfect selection of records in case of clumsy or highly dispersed data, Also to provide navigation facility in case of zoomed plotting area, Researcher design & develop a model to extract the plotted data
in the form of some table by taking a Fractal shape as graphical selector with zoom-in, zoom-out and navigation facility to create a cluster. Thus following model was designed and prototype was developed by researcher to fulfill requirements specified above in section 4.1.

4.4.1 Components of the Clustering Model to extract plotted data in the form of table by taking Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(a) Fractal_Cluster_With_Zoom_With_Navigation

It is a main component of the model on which all the other components like Plotting area, Graphical selector, Navigation_Area, Zoom-In, Zoom-Out, Lock_Zoom, Data Populator, Data Grid, Total Sales and Average Sales are placed.

![Fractal_Cluster_with_Zoom_with_Navigation](image)

Figure 4.32 Fractal_Cluster_with_Zoom_with_Navigation, the main component of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(b) Cluster Database:

Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created cluster table from which records are fetched and displayed on the Plotting area. Also all the records selected by graphical selector are first compared with the field lx and ly of cluster table and then stored into the data grid. The structure of the Cluster database and cluster table as well a
recordset are same as define with table 4.2.2. Thus these components are not defined in detail.

(c) Plotting area:
The design and the functionality of this component is as same as the component of model 4.1.1 (c) Plotting area. Thus it is not redefine over here.

(d) Navigation area
Navigation area is the component of the model that allow to move plotting area within the bound of itself. Whenever user enlarges or shrink the size of plotting area to perfectly select the records, at that time user can navigate the plotting area within the bound of navigation area.

Figure 4.33 Navigation Area, the main component of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(e) Graphical Selector
Graphical Selector is the component of the model that is used to select records from the plotted area. Researcher has provided the way where user can create a fractal shape cluster. For this End-user has to click on the plotting area where he/she wants to create cluster. The Fractal shape cluster will be drawn as user moves mouse pointer to select and bound records within the plotting area. Once user release the left mouse button a line will be automatically drawn between the starting point and the ending
points of the cluster. This will create the fractal shape and all the desired records will be bounded by this closed fractal shape.

![Graphical Selector](image)

Figure 4.34 Graphical Selector, the component of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(f) **Zoom_In**

This component is used to enlarge or zoom the plotting area by 200%. When ever plotting area is clumsy and user wants to distinguish between records to be selected and records not to be selected, then user clicks on this zoom_in button so that all the desirable records can be selected perfectly.

![Zoom_In](image)

Figure 4.35 Zoom_In, the component of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(g) **Zoom_Out**

This component is used to shrink or zoom out the plotting area by 50%. Whenever maximum part of the plotting area is to be clustered then it may be difficult to select all the desirable records within the fractal cluster. At that time user can shrink or zoom out the plotting area by clicking this component.

![Zoom_Out](image)

Figure 4.36 Zoom_Out, the component of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.
(h) **Lock_Zoom**
This component is used to disable the zoom-in and zoom-out and to disable the navigation of plotting area. Once the plotting area is perfectly visible, user has to click this component to disable the zooming process and navigation process of plotting area, so that plotting area remain as it is when user draw a cluster on the plotting area.

![Lock_Zoom](image)

Figure 4.37 Lock_Zoom, the component of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(i) **Data Populator**
The design and the functionality of this component is as same as the component of model 4.1.1 (e) **Data Populator**. Thus it is not redefine over here.

(j) **Data Grid**
The design and the functionality of this component is as same as the component of model 4.1.1 (f) **Data Grid**. Thus it is not redefine over here.

(k) **Total Sales**
The design and the functionality of this component is as same as the component of model 4.1.1 (g) **Total Sales**. Thus it is not redefine over here.

(l) **Average Sales Labels**
The design and the functionality of this component is as same as the component of model 4.1.1 (h) **Average Sales**. Thus it is not redefine over here.

**4.4.2 Development of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.**

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [5,6,7,8].

‘Declaration of global variable and declaration of connection object and recordset object to be used’
Option Explicit
Private Const HALFTONE As Long = 4
Private Declare Function StretchBlt Lib "gdi32" (ByVal hdc As Long, _
ByVal x As Long, _
ByVal y As Long, _
ByVal nWidth As Long, _
ByVal nHeight As Long, _
ByVal hSrcDC As Long, _
ByVal xSrc As Long, _
ByVal ySrc As Long, _
ByVal nSrcWidth As Long, _
ByVal nSrcHeight As Long, _
ByVal dwRop As Long) As Long
Private Declare Function SetStretchBltMode Lib "gdi32" (ByVal hdc As Long, _
ByVal nStretchMode As Long) As Long
Dim sx, sy, tx, ty, ZX, ZY, rc As Long
Dim maxx, maxy, minx, miny As Long
Dim ax, ay, bx, by As Long
Dim i, j, k As Long
Dim Z, t, m, op As Integer
Dim cn1 As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim TS As Double
Dim sales() As Variant

‘An event executed when user starts the execution of the program and also used
to open connection-recordset as well as to define the datagrid.’
Private Sub Form_Load()
t = 0
Z = 1
op = 0
rc = 0
Picture1.ForeColor = vbBlue
msf1.Rows = 1
msf1.Cols = 4
Set cn1 = New ADODB.Connection
    cn1.CursorLocation = adUseClient
    cn1.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist
Security Info=False"
Set rs1 = New Recordset
    rs1.Open "cluster", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdTable
msf1.ColWidth(0) = 1500
For k = 0 To 3
    msf1.TextMatrix(0, k) = rs1.Fields(k).Name
Next k
End Sub

‘Command button defined as Data Populator, when clicked fetches the data
from database and displays the data on plotting area.

Private Sub Command1_Click()
rc = 0
Picture1.Cls
rs1.MoveFirst
Picture1.ForeColor = vbRed
While (rs1.EOF <> True)
  ReDim Preserve sales(3, rc)
  ZX = rs1.Fields(1).Value
  ZY = rs1.Fields(2).Value
  sales(0, rc) = rs1.Fields(0).Value
  ZX = ZX * Z
  ZY = ZY * Z
  ZX = Int(ZX)
  ZY = Int(ZY)
  sales(1, rc) = ZX
  sales(2, rc) = ZY
  rc = rc + 1
  Picture1.PSet (ZX, ZY), vbRed
  Picture1.PSet (ZX - 1, ZY), vbMagenta
  Picture1.PSet (ZX + 1, ZY), vbMagenta
  Picture1.PSet (ZX, ZY + 1), vbMagenta
  Picture1.PSet (ZX, ZY - 1), vbMagenta
  Picture1.PSet (ZX - 1, ZY + 1), vbMagenta
  Picture1.PSet (ZX - 1, ZY - 1), vbMagenta
  Picture1.PSet (ZX + 1, ZY + 1), vbMagenta
  Picture1.PSet (ZX + 1, ZY - 1), vbMagenta
  Picture1.ForeColor = vbMagenta
  Picture1.Print rs1.Fields(0).Value
  rs1.MoveNext
Wend
Picture1.ForeColor = vbBlue
End Sub

‘An event executed when user clicks lock_zoom button disable the zooming process and navigation process and wants to start drawing a fractal shape cluster’
Private Sub Command2_Click()
op = 1
End Sub

‘An event executed automatically whenever user performs zoom-in or zoom-out operations at that time to maintain the resolution and visibility it calls the zoomprocess.
Private Sub Form_Activate()
Call ZOOMPROCESS
End Sub

‘An event executed when user clicks left mouse button and starts drawing a fractal shape cluster’
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, x As Single, y As Single)
    If op = 1 Then
        sx = x
        sy = y
        tx = x
        ty = y
        minx = x
        miny = y
        maxx = x
        maxy = y
        t = 1
    Else
        ax = x
        ay = y
    End If
End Sub

‘An event executed when user moves mouse pointer on the plotting area to define and draw fractal shape with graphical selector.’
Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, x As Single, y As Single)
    If op = 1 Then
        If t = 1 Then
            If minx > x Then
                minx = x
            End If
            If miny > y Then
                miny = y
            End If
            If maxx < x Then
                maxx = x
            End If
            If maxy < y Then
                maxy = y
            End If
            Picture1.Line (tx, ty)-(x, y)
            tx = x
            ty = y
        End If
    End If
End Sub

‘An event executed when user releases the mouse button it start the fetching of data from the database according to the records selected on the plotting area and fill the data grid with this selected records’
Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, x As Single, y As Single)
    If op = 1 Then
        TS = 0
    End If
t = 0
Picture1.Enabled = False
Dim flg As Integer
Dim i1, j1, k1 As Long
Dim m1, m2 As Integer
i1 = 1000
j1 = 1000
k = 1
Picture1.Line (x, y)-(sx, sy)
MsgBox ("Please Wait While Result Is Generated")
For j = miny To maxy
  flg = 0
  For i = minx To maxx
    If Picture1.Point(i, j) = vbBlue Then
      If (j = j1 And i = i1 + 1) = False Then
        flg = flg + 1
      End If
      i1 = i
      j1 = j
    End If
    If Picture1.Point(i, j) = vbRed Then
      MsgBox (i & "-mouse-" & j)
      MsgBox (flg)
      If flg Mod 2 = 1 Then
        For k1 = 0 To rc - 1
          If sales(1, k1) = i And sales(2, k1) = j Then
            MsgBox ("came in selected")
            rs1.MoveFirst
            While rs1.EOF <> True
              If rs1.Fields(0).Value = sales(0, k1) Then
                msf1.Rows = msf1.Rows + 1
                msf1.TextMatrix(k, 0) = rs1.Fields(0).Value
                msf1.TextMatrix(k, 1) = rs1.Fields(1).Value
                msf1.TextMatrix(k, 2) = rs1.Fields(2).Value
                msf1.TextMatrix(k, 3) = rs1.Fields(3).Value
                TS = TS + rs1.Fields(3).Value
                k = k + 1
              End If
            rs1.MoveNext
            Wend
          End If
        Next k1
      End If
    End If
  Next i
Next j
l1.Caption = TS
l2.Caption = TS / (k - 1)
Else
  bx = x
by = y
Picture1.Top = Picture1.Top + by - ay
Picture1.Left = Picture1.Left + bx - ax
Call Command1_Click
End If
End Sub

'An event executed when user clicks this button to enlarge or to zoom-in plotting area so that desired records can be visible easily and selected perfectly.
Private Sub ZOOMIN_Click()
Z = Z * 2
'zoom in by 200%
With Picture1
 .Move 0, 0, .Width * 2, .Height * 2
 .Cls
  StretchBlt .hdc, 0, 0, .ScaleWidth, .ScaleHeight, Picture2.hdc, 0, 0, _
  Picture2.ScaleWidth, Picture2.ScaleHeight, vbSrcCopy
End With 'Picture1
Picture1.Picture = Picture1.Image
Call Command1_Click
End Sub

'An event executed when user clicks this button to shrink or to zoom-out plotting area in case were desired records are highly dispersed and user wants to bound or select all these records
Private Sub ZOOMOUT_Click()
Z = Z / 2
'zoom out by 50%
With Picture1
 .Move 0, 0, .Width / 2, .Height / 2
 .Cls
  StretchBlt .hdc, 0, 0, .ScaleWidth, .ScaleHeight, Picture2.hdc, 0, 0, _
  Picture2.ScaleWidth, Picture2.ScaleHeight, vbSrcCopy
End With 'Picture1
Picture1.Picture = Picture1.Image
Call Command1_Click
End Sub

'An event executed whenever the main component of the model is resized or whenever the zoom-in and zoom-out process is executed. This event is special event used to maintain the resolution quality of the plotting area whenever user performs zoom-in or zoom-out process.
Private Sub ZOOMPROCESS()
Picture2.PaintPicture Picture1.Picture, 0, 0, Picture1.ScaleWidth, Picture1.ScaleHeight
Picture2.Picture = Picture2.Image
With Picture2 'source
 .AutoRedraw = True
 .ScaleMode = vbPixels
 .Visible = False
 ' .AutoSize = True 'use if loading a graphic
End With
With Picture1 'dest
'I've heard this improves quality
SetStretchBltMode .hdc, HALFTONE
.AutoRedraw = True
.ScaleMode = vbPixels
.Move 0, 0, Picture2.Width, Picture2.Height
.Picture = Picture2.Image
'Picture1.Print "Some Picture 1111111Box Text"
End With
MsgBox ("Process is over, Plz continue the task")
End Sub

4.2.4 Steps to implement the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.

![First step of implementation of the Clustering Model](image)

Figure 4.38 First step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on plotting area.
(b) When Data Populator is clicked
When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the plotting area. The top-left values are corresponding values of the lx and ly field of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on plotting area.

![Image](image_url)

Figure 4.39 Second step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(c) When user clicks on zoom-out component and moves mouse pointer
When user clicks on zoom-out the plotting areas height and width decreases by 50% and plotting area reduced by 75%. This step is optional step and executed by user when he/she wants to include most of the plotted records within the bound of cluster. User can increase /decrease the size of plotting area until and unless lock_zoom component is clicked
Figure 4.40 Third (Optional) step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

(d) When user clicks on plotting area and drag plotting area. (After Zoom-In)

Figure 4.41 Fourth (Optional) step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

This step is optional step and executed by the user for better view and selection user may want to move plotting area within the bound of navigation area. For such user can click and drag plotting area in the desired direction and location. User can move plotting area until and unless lock_zoom component is clicked

(e) When user clicks on zoom-In component
When user clicks on zoom-In the plotting areas height and width increased by 100% and plotting area is increased by 400%. This step is optional step and executed by user when plotting area is very much clumsy with the records and user wants to perfectly select the records from the plotting area within the bound of fractal shape. User can increase /decrease the size of plotting area until and unless lock_zoom component is clicked.

(f) **When user clicks and drag plotting area (After Zoom-In).**

Once user clicks on zoom-in the size of the plotting area will be increased by 400%. Thus whole plotting area may not be visible and hence all the desired records may not be visible. Thus in such case user may require to navigate plotting area in such a way so that all the desired records may become visible. User can move plotting area until and unless lock_zoom component is clicked. Following figure 4.43 describes that plotting area has been navigated towards the right-bottom direction by clicking mouse pointer on plotting area and dragging it towards the bottom-right direction. Figure 4.44 indicates that plotting area has been navigated towards the top-left direction by clicking mouse pointer on plotting area and dragging it towards the top-left direction. Thus whenever plotting area is zoomed in and whenever desired part of plotting area is not visible, User can make it visible by clicking and dragging plotting area.
Figure 4.43 Sixth (Optional) step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

Figure 4.44 Seventh (Optional) step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(g) **When user clicks on Lock_Zoom Component.**

After navigation once the plotting area with desired records is visible, User clicks on Lock_zoom component that disables the Zoom_In, Zoom_out and navigation process of plotting area. To draw fractal shape cluster it is compulsory to disable these processes as plotting area keeps on navigatin whenever user clicks and drag mouse.
button on plotting area. Thus creation of fractal cluster will only start after disabling the zooming and navigation process.

Figure 4.45 Seventh step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

(h) When user clicks on plotting area to draw cluster

Once user clicks on plotting area, he/she is allowed to draw or define fractal shape cluster. For such user has to click somewhere on plotting area near to one of the records he/she wants to bound within cluster and then wherever user move mouse pointer fractal shape will be drawn accordingly. Thus user has to move mouse pointer in such a way so that his/her desired records can be selected within the bound of fractal cluster. Figures 4.46 and figure 4.47 shows that wherever user moves mouse pointer, fractal shape is drawn accordingly. Thus user can create the cluster of any shape and that gives the maximum flexibility to user to select all the desired records within the bound of fractal cluster. Only care has to be taken by end user is that he/she has to draw a fractal in such a way so that all the desired records comes within the fractal shape and starting point of the cluster and the ending point at which user is going to release the mouse button must be nearer so that user can get the 100% perfection in terms of selection of records. For example if user want to cluster records with customer_no= \{4,10,11,17,18,19,20,24,25,26\} and if user release the mouse at end point as define in figure 4.46 then customer_no 19,20 may not be cluster or bound within the fractal shape cluster as there will be a line automatically drawn from ending point to the starting point. Instead of that if user draw a fractal like defined in
figure 4.47 then all the desired records will be bound and selected within the closed fractal shape cluster.

(i) When user release the mouse button

When user releases the mouse button immediately a line is drawn between the starting point and ending point of cluster and thus forming close end cluster. All the records
bounded within the fractal shape cluster becomes set of selected records and appears on the data grid area.

Figure 4.48 Tenth step of implementation of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

Enlarged view of plotting area & graphical selector (Figure 4.49) and data grid (Figure 4.50) are described below which clearly states that those records selected by the user with the fractal shape graphical selectors appears in the data grid. Also total sales and average sales are also calculated for the sales amount of those customers whose records are selected through the graphical selector from the plotting area.

<table>
<thead>
<tr>
<th>Customer_No</th>
<th>bx</th>
<th>ly</th>
<th>sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>320</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>240</td>
<td>160</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>320</td>
<td>160</td>
<td>10</td>
</tr>
<tr>
<td>17</td>
<td>240</td>
<td>240</td>
<td>15</td>
</tr>
<tr>
<td>18</td>
<td>320</td>
<td>240</td>
<td>15</td>
</tr>
<tr>
<td>19</td>
<td>400</td>
<td>240</td>
<td>25</td>
</tr>
<tr>
<td>20</td>
<td>400</td>
<td>240</td>
<td>25</td>
</tr>
<tr>
<td>24</td>
<td>240</td>
<td>320</td>
<td>35</td>
</tr>
<tr>
<td>25</td>
<td>320</td>
<td>320</td>
<td>35</td>
</tr>
<tr>
<td>26</td>
<td>400</td>
<td>320</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 4.49 Enlarged view of plotting area and graphical selector of figure 4.48
4.4.3 Key Features of the Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

- The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.

- This model eliminates the limitation of previous model 4.3 in case of clumsy data on plotting area by providing the facility of zoom-in and zoom-out of the plotting area and navigation of plotting area. End user can get the enlarged view of plotting area as per the requirement by clicking zoom-in component. Also to make visible all the records when plotting area is enlarged, navigation facility is provided. Thus user can enlarge the plotting area as to make the plotting area best visible and then navigate plotting area as per the requirement to perfectly select the desired records.

- This model also eliminates the limitation of previous model 4.3 in case of requirement of selection of large area within the bound of cluster. For this plotting area is required to be shrink. This facility is provided with the zoom-
out control with which user can decrease the size of plotting area as per the requirement and then allow to navigate plotting area to perfectly select the records to create fractal cluster

- End user is getting the flexibility of drawing any shape of cluster as model allows to form the cluster as user moves mouse pointer on the plotting area. Thus not restricted with circular, rectangle or any other shape and thus removes the limitation of previous models. User can define a cluster in a way so that 100% of desired records can be bounded or can be selected to be clustered

- Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

- End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales already given with the model as selected records are easily accessible from the data.

### 4.4.4 Limitations of Clustering Model to extract plotted data in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

- Difficult to map with real life application requirement as researcher has assumed some x and y coordinate values for the customer location on the plotting area.

- Instead of representing customer location with some longitude and latitude, customer locations are represented with some assumed x and y coordinate values on plotting area.

- To get the actual x and y coordinates value that represent longitude and latitude value of customer location, every time it is required to convert longitude and latitude value into the appropriate x and y coordinates value.

- Also as facility of enlarging and shrinking plotting area are provided, it becomes more difficult to convert longitude and latitude value into the respective x and y coordinates values whenever plotting area is enlarged or shrink.
After analyzing above define limitations and problems researcher decided to design & develop model with real map representing customer’s location on plotting area with some longitude and latitude values. Thus researcher decided to again design and develop all the previously defined models with actual map represented as plotting area and customer location to be presented with latitude and longitude. For this researcher has selected the map of Gujarat state as if model map and to be plotted on plotting area and some location of Gujarat state with their longitude and latitude values are selected and plotted on the map.

4.5 Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

As researcher has decided to develop models with actual map, Clustering model 4.1 was again designed & developed to extract the plotted data from the map in the form of some table by taking a Rectangle shape as graphical selector to create a cluster. Thus following model was designed and prototype was developed by researcher.

4.5.1 Components of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

(a) Rect_Cluster

It is a main component of the model on which all the other components like model map of Gujarat state, graphical selector, Data Populator, Data Grid, Total Sales and Average Sales are placed.
(b) Cluster Database:
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created 2 tables (1) Customer table which is used to store the customer’s location in terms of longitude and latitude and from which customers location information are fetched and displayed on the model map (2) Sales table from which records are fetched and displayed in the datagrid which contains the sales transactions carried out with the customers selected by the graphical selector. Here all the records selected by graphical selector are first compared with the field logx(longitude) and laty(latitude) of customer table and their corresponding customer number are stored temporarily into an array and in last these values are compared with the customers number of the sales table and those records whose customer numbers are matched are stored into the data grid. The structure of the Cluster database and both tables as well as records are same as define with table 4.6.2 and 4.6.3 Thus these components are not defined in detail.

(c) Model Map:
Researcher has captured the map of Gujarat state as model map. This map is plotted and used as the component of the model that is used to display all the records of the customer table on the screen. Records are displayed on plotting area at specific top-
left values where top is corresponding to the laty (latitude) field value and left is corresponding to the logx (longitude) field value of the specific customer’s location from the customer table [9].

Figure 4.52 Model map, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

(d) Graphical Selector

Graphical Selector is the component of the model that is used to select records from the model map. Researcher has provided the rectangle shape as graphical selector tool. End-user has to click on the map area where he/she wants to create cluster. Here rectangle shape will appear once user click left mouse button and it will move with the fixed starting point in the direction of mouse pointer and its size will be also increased and decreased in the direction of the mouse pointer and this movement will be continue until and unless end-user releases the left mouse button.
Figure 4.53 Graphical Selector, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

(e) **Data Populator**

Data Populator is the component of the model that performs the process to display records on the model map area. When user clicks on this component, it starts the process of fetching records from the table and displays the records on the model map area.

![Populate Data](image)

Figure 4.54 Data Populator, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

(f) **Data Grid**
DataGrid is the component of the model that is responsible to store & display the records selected by graphical selector. When user completes the process of selecting records with graphical selector and when user releases the mouse, immediately the process of storing and displaying starts in the data grid and it is populated with the selected records.

4.5.2 Development of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [3,5,7,8].

‘Declaration of global variable and declaration of connection object and recordset object to be used’
Option Explicit
Dim sx, sy, ex, ey As Long
Dim cn As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim rs9 As ADODB.Recordset
Dim sales() As Variant
Dim zx, zy, rc As Long
‘An event executed when user starts the execution of the program and also used to open connection-recordset as well as to define the datagrid and shape’
Private Sub Form_Load()
    sp.Shape = 0
    rc = 0
    sp.BorderColor = vbBlue
    Set cn = New ADODB.Connection
    cn.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
    Set rs1 = New Recordset
    Set rs9 = New Recordset
    rs1.Open "customer", cn, adOpenDynamic, adLockBatchOptimistic, adCmdTable
    rs9.Open "select * from monthly_sales", cn, adOpenDynamic, adLockBatchOptimistic, adCmdText
    msf1.Cols = 5
    msf1.Rows = 1
End Sub

‘Command button defined as Data Populator, when clicked fetches the data from database and displays the data on model map area.
Private Sub Command1_Click()
    rc = 0
    Dim LOGP, LATP, CLOG, CLAT As Double
    Dim PX, PY As Long
    LOGP = (68.00537109375 - 75.03662109375) / 640
    LATP = (26.30326423939 - 19.839060009305) / 640
    Picture1.Cls
    rs1.MoveFirst
    Picture1.ForeColor = vbRed
    While (rs1.EOF <> True)
        ReDim Preserve sales(2, rc)
        CLOG = rs1.Fields(1).Value
        CLAT = rs1.Fields(2).Value
        PX = ((68.00537109375 - CLOG)) / LOGP
        PY = ((26.30326423939 - CLAT)) / LATP
        zx = CInt(PX)
        zy = CInt(PY)
        sales(0, rc) = rs1.Fields(0).Value
        sales(1, rc) = zx
        sales(2, rc) = zy
        rc = rc + 1
        Picture1.PSet (zx, zy), vbRed
        Picture1.PSet (zx - 1, zy), vbMagenta
        Picture1.PSet (zx + 1, zy), vbMagenta
        Picture1.PSet (zx, zy + 1), vbMagenta
        Picture1.PSet (zx, zy - 1), vbMagenta
        Picture1.PSet (zx - 1, zy + 1), vbMagenta
        Picture1.PSet (zx + 1, zy + 1), vbMagenta
        Picture1.PSet (zx - 1, zy - 1), vbMagenta
        Picture1.PSet (zx + 1, zy - 1), vbMagenta
    Wend
Picture1.ForeColor = vbMagenta
Picture1.Print rs1.Fields(0)
rs1.MoveNext
Wend
Picture1.ForeColor = vbBlue
End Sub

‘An event executed when user clicks left mouse button and starts drawing a rectangle shape cluster’
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
sp.Top = X
sp.Left = Y
sp.Visible = True
sx = X
sy = Y
End Sub

‘An event executed when moves mouse pointer on the model map area to increase decrease the size of graphical selector in form of rectangle shape’
Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
On Error Resume Next
If Button = vbLeftButton Then
    sp.Visible = True
If X > sx And Y > sy Then
    sp.Left = sx
    sp.Top = sy
    sp.Width = ex - sx
    sp.Height = ey - sy
End If
If X < sx And Y > sy Then
    sp.Left = X
    sp.Top = sy
    sp.Width = sx - ex
    sp.Height = ey - sy
End If
If X > sx And Y < sy Then
    sp.Left = sx
    sp.Top = Y
    sp.Width = ex - sx
    sp.Height = sy - ey
End If
If X < sx And Y < sy Then
    sp.Left = X
    sp.Top = Y
    sp.Width = sx - ex
    sp.Height = sy - ey
End If
ex = X
ey = Y
End If
End Sub

‘An event executed when user releases the mouse button it start the fetching of
data from the database according to the records selected on the model map and
fill the data grid with this selected records’

Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
Dim ts As Currency
Dim t As Long
Dim LOGP, LATP, CLOG, CLAT As Double
Dim PX, PY, k1, k As Long
LOGP = (68.00537109375 - 75.03662109375) / 640
LATP = (26.30326423939 - 19.839060009305) / 640
k = 0
ex = X
ey = Y
If sx > ex Then
    t = sx
    sx = ex
    ex = t
End If
If sy > ey Then
    t = sy
    sy = ey
    ey = t
End If
ts = 0
msf1.Clear
msf1.Rows = 1

For k = 1 To 4
    msf1.TextMatrix(0, k) = rs9.Fields(k - 1).Name
Next k
k = 1
For k1 = 0 To rc - 1
    If (sales(1, k1) >= sx And sales(2, k1) >= sy) Then
        If (sales(1, k1) <= ex And sales(2, k1) <= ey) Then
            rs9.MoveFirst
            While (rs9.EOF <> True)
                If sales(0, k1) = rs9.Fields(0) Then
                    msf1.Rows = msf1.Rows + 1
                    msf1.TextMatrix(k, 0) = k
                    msf1.TextMatrix(k, 1) = rs9.Fields(0)
                    msf1.TextMatrix(k, 2) = rs9.Fields(1)
                    msf1.TextMatrix(k, 3) = rs9.Fields(2)
                    msf1.TextMatrix(k, 4) = rs9.Fields(3)
                    k = k + 1
                End If
            End While
        End If
    End If
Next k1
4.2.5 Steps to implement the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.

![Figure 4.56 First step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.](image)

When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on the map.

(b) When Data Populator is clicked
Figure 4.57 Second step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the model map. The top-left values are corresponding values of the longitude and latitude values of the customer location of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on the map.

(c) When user clicks on the map and moves mouse pointer

When user clicks on actual map area, the rectangle shape graphical selector appears on the map and its size can be increased or decreased as per the users requirement to select desired records. User can cluster the desired records by selecting it with customized rectangle shape cluster.
(d) When user release the mouse button

When user releases the mouse the rectangle shape cluster is created and the cluster that was sizable earlier becomes fix on the map area. All the records bounded within the rectangle shape cluster are becomes set of selected records and appears in the data grid area.
Enlarged view of map area & graphical selector (Figure 4.60) and data grid (Figure 4.61) are described below which clearly states that those records selected by the user with the rectangle graphical selectors appears in the data grid. As it can be seen in figure 4.60 that Customer number \{12,65,21,52,39,66,1,53,15,43,9,66,38,40,3,54\} are selected within the bound of rectangle shape cluster, all such selected records appears in the data grid when user releases the mouse which is defined below in figure 4.61.

Figure 4.60 Enlarged view of map area & Graphical selector of Figure 4.59
4.5.3 Key Features of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

- Unlike the previously defined model 4.2, this model makes the use of actual map of Gujarat state as model map instead of plotting area and clustering is performed on the base of longitude and latitude values instead of imaginary x and y coordinates of customer location. Thus model application can be mapped very easily with the real life application.

- Another major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.

- With utmost flexibility user can draw a cluster that covers or bound 100% desired records with the rectangle shape cluster. This rectangle shape of the cluster can be increased to cover more area or to include more records and can be decreased as per the end-user conveniences.
Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales selected records are easily accessible from the data grid.

4.5.4 Limitations of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Rectangle as graphical selector.

- Model application only allows to form the cluster in the rectangle shape only that reduces the flexibility and accuracy of the end user in terms of selection of records.
- Once user has decided the area to be clustered and when he/she clicks on the plotting area, that point becomes fixed starting point of the rectangle shape cluster. Of course user can increase/ decrease the size of cluster but cannot move cluster on other position.
- If requirement of creating cluster in circular shape or fractal shape then this model may not be useful. For example if data to be cluster is with some central point and within specific radius or fractal shape of cluster is to be formed.

After analyzing above define limitation researcher decided to design & develop another model that can provide better way of selection of records and cluster to be created should be sizable as well as movable. Thus researcher design & develop a new Clustering Model to extract plotted data from the map in the form of table by taking a Circle as graphical selector and the actual map of Gujarat state instead of plotting area.

4.6 Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle as graphical selector.

As researcher has decided to design develop models with actual map and to provide clustering process with circle shape, Clustering model 4.3 was again designed & developed to extract the plotted data from the map in the form of some table by taking
a Circle shape as graphical selector to create a cluster. Thus following model was designed and the prototype was developed by researcher.

4.6.1 Components of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle as graphical selector.

(a) Circular_Cluster
It is a main component of the model on which all the other components are placed like model map of Gujarat state, graphical selector, Data Populator and Data Grid.

(b) Cluster Database:
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created 2 tables (1) Customer table which is used to store the customer’s location in terms of longitude and latitude and from which customers location information are fetched and displayed on the model map (2) Sales table from which records are fetched and displayed in the datagrid which contains the sales transactions carried out with the customers selected by the graphical selector. Here all the records selected by graphical selector are first compared with the field logx(longitude) and laty(latitude) of customer table and their corresponding customer number are stored temporarily into an array and in last these values are
compared with the customers number of the sales table and those records whose customer numbers are matched are stored into the data grid. The structure of the Cluster database and both tables as well as records are same as define with table 4.6.2 and 4.6.3 Thus these components are not defined in detail.

(c) Model Map:

![Model Map](image)

Figure 4.63 Model map, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle shape as graphical selector.

Researcher has captured the map of Gujarat state as model map. This map is plotted and used as the component of the model that is used to display all the records of the customer table on the screen. Records are displayed on plotting area at specific top-left values where top is corresponding to the laty (latitude) field value and left is corresponding to the logx (longitude) field value of the specific customer’s location from the customer table [9].
(d) **Graphical Selector**

Graphical Selector is the component of the model that is used to select records from the model map. Researcher has provided the Circle shape as graphical selector tool. End-user has to click on the map area where he/she wants to create cluster. Here Circle shape will appear once user click left mouse button and it will move with the in the direction of mouse pointer and its size will be also increased and decreased by clicking the right mouse button and this movement will be continue until and unless end-user double clicks the left mouse button.

![Graphical Selector](image)

Figure 4.64 Graphical Selector, the component of Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle shape as graphical selector.

(e) **Data Populator**
The design and the functionality of this component is as same as the component of model 4.5.1 (e) Data Populator. Thus it is not redefine over here.

(f) Data Grid
The design and the functionality of this component is as same as the component of model 4.5.1 (f) Data Grid. Thus it is not redefine over here.

4.6.2 Development of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle as graphical selector.
To develop a program for above describe model researcher has written the code in VB 6.0 which is define below. [2,3,6,7]

‘Declaration of global variable and declaration of connection object and recordset object to be used’
Option Explicit
Dim sx, sy, tx, ty As Long
Dim maxx, maxy, minx, miny As Long
Dim cx, cy As Long
Dim i, j, k As Long
Dim t As Integer
Dim cn1 As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim rs9 As ADODB.Recordset
Dim sales() As Variant
Dim rc As Long
Dim rd As Integer

‘An event executed when user starts the execution of the program and also used to open connection-recordset as well as to define the datagrid and shape’
Private Sub Form_Load()
t = 0
rc = 0
rd = 50
Picture2.ForeColor = vbBlue
msf1.Rows = 1
msf1.Cols = 5
Set cn1 = New ADODB.Connection
    cn1.CursorLocation = adUseClient
    cn1.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
Set rs1 = New Recordset
    rs1.Open "customer", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdTable
Set rs9 = New Recordset
rs9.Open "select * from monthly_sales", cn1, adOpenDynamic, 
adLockBatchOptimistic, adCmdText
msf1.TextMatrix(0, 0) = "SNO"
msf1.TextMatrix(0, 1) = rs9.Fields(0).Name
msf1.TextMatrix(0, 2) = rs9.Fields(1).Name
msf1.TextMatrix(0, 3) = rs9.Fields(2).Name
msf1.TextMatrix(0, 4) = rs9.Fields(3).Name
End Sub

‘An event executed when user starts the execution of the program and wants to
repaint the screen
Private Sub Form_Activate()
    MousePointer = 11
    Picture1.PaintPicture Picture2.Image, 0, 0, Picture1.Width, Picture1.Height,
    Picture1.Left, Picture1.Top, Picture1.Width, Picture1.Height
    Picture1.Line (1, 1) - (Picture1.Width - 1, Picture1.Height - 1), , B
    MousePointer = 0
End Sub

‘Command button defined as Data Populator, when clicked fetches the data
from database and displays the data on plotting area.
Private Sub Command1_Click()
rc = 0
    Dim LOGP, LATP, CLOG, CLAT As Double
    Dim PX, PY, zx, zy As Long
    LOGP = (68.00537109375 - 75.03662109375) / 640
    LATP = (26.30326423939 - 19.839060009305) / 640
    Picture2.Cls
    rs1.MoveFirst
    Picture2.ForeColor = vbRed
    While (rs1.EOF <> True)
        ReDim Preserve sales(2, rc)
        CLOG = rs1.Fields(1).Value
        CLAT = rs1.Fields(2).Value
        PX = ((68.00537109375 - CLOG)) / LOGP
        PY = ((26.30326423939 - CLAT)) / LATP
        zx = CInt(PX)
        zy = CInt(PY)
        sales(0, rc) = rs1.Fields(0).Value
        sales(1, rc) = zx
        sales(2, rc) = zy
        rc = rc + 1
        Picture2.PSet (zx, zy), vbRed
        Picture2.PSet (zx - 1, zy), vbMagenta
        Picture2.PSet (zx + 1, zy), vbMagenta
        Picture2.PSet (zx, zy + 1), vbMagenta
        Picture2.PSet (zx, zy - 1), vbMagenta
        Picture2.PSet (zx - 1, zy + 1), vbMagenta
        Picture2.PSet (zx + 1, zy + 1), vbMagenta
        Picture2.PSet (zx - 1, zy - 1), vbMagenta
    End While
Picture2.PSet (zx + 1, zy - 1), vbMagenta
Picture2.ForeColor = vbMagenta
Picture2.Print rs1.Fields(0)
rs1.MoveNext
Wend
Picture2.ForeColor = vbBlue
Call pictrefresh
End Sub

‘An event executed when user clicks left mouse button and starts drawing a circular shape cluster as well as when user clicks right mouse button to change the size of graphical selector’

Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
If Button = 1 Then
    minx = X - rd
    miny = Y - rd
    maxx = X + rd
    maxy = Y + rd
    cx = X
cy = Y
    Picture1.ForeColor = vbBlue
    Picture1.Circle (cx, cy), rd
t = 1
End If
If Button = 2 Then
    rd = rd * 1.2
End If
End Sub

‘An event executed when user moves mouse pointer on the plotting area to move graphical selector that is form of circular shape’

Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
    minx = X - rd
    miny = Y - rd
    maxx = X + rd
    maxy = Y + rd
    cx = X
cy = Y
    If t = 1 Then
        Call pictrefresh
        Picture1.Circle (cx, cy), rd
    End If
End Sub

‘An event executed when user double clicks left mouse button and it initiates the process of fetching of data from the database according to the records selected on the plotting area and fill the data grid with this selected records’

Private Sub Picture1_DblClick()
Dim LOGP, LATP, CLOG, CLAT As Double
Dim PX, PY, k1 As Long
LOGP = (68.00537109375 - 75.03662109375) / 640
LATP = (26.30326423939 - 19.839060009305) / 640
k = 1
t = 0
Picture1.Enabled = False
Dim flg As Integer
Dim i1, j1 As Long
i1 = 640
j1 = 640
MsgBox ("Please Wait While Result Is Generated")
For j = miny To maxy
    flg = 0
    For i = minx To maxx
        If Picture1.Point(i, j) = vbBlue Then
            If (j = j1 And i = i1 + 1) = False Then
                flg = flg + 1
            End If
            i1 = i
            j1 = j
        End If
        If Picture2.Point(i, j) = vbRed Then
            If flg Mod 2 = 1 Then
                For k1 = 0 To rc - 1
                    If sales(1, k1) = i And sales(2, k1) = j Then
                        rs9.MoveFirst
                        While (rs9.EOF <> True)
                            If sales(0, k1) = rs9.Fields(0) Then
                                msf1.Rows = msf1.Rows + 1
                                msf1.TextMatrix(k, 0) = k
                                msf1.TextMatrix(k, 1) = rs9.Fields(0)
                                msf1.TextMatrix(k, 2) = rs9.Fields(1)
                                msf1.TextMatrix(k, 3) = rs9.Fields(2)
                                msf1.TextMatrix(k, 4) = rs9.Fields(3)
                                k = k + 1
                            End If
                            rs9.MoveNext
                        Wend
                    End If
                Next k1
            End If
        End If
    Next i
Next j
End Sub

'The function which is called by various events like mouse_down, mouse_up, mouse_move to repaint the picture every time when user moves the graphical selector, increases the size of graphical selector
Private Sub pictrefresh()
MousePointer = 11
End Sub

4.2.6 Steps to implement the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle as graphical selector & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.

When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on the map.

![First step of implementation of the Clustering Model](image)

Figure 4.65 First step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle shape as graphical selector.

(b) When Data Populator is clicked

When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the model map. The top-left values are corresponding values of the longitude and latitude.
values of the customer location of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on the map.

(c) **When user clicks on the map and moves mouse pointer**

When user clicks on plotting area, the circular shape graphical selector appears on the model map of Gujarat state and its size can be increased or decreased as per the users requirement to select desired records. Also user can move this graphical selector to select desired record without the bound of fixed starting point. User can cluster the desired records by selecting it with customized circular shape cluster.
(d) When user moves the circle shape cluster on the map (Optional)

Figure 4.68 Fourth step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle shape as graphical selector.

When user clicks on plotting area, the circular shape graphical selector appears on the model map of Gujarat state. This graphical selector can be moved in any direction on the map by dragging mouse pointer in such direction to select desired record without the bound of fixed starting point.

(e) When user right clicks on plotting area and moves mouse pointer (optional)

When researcher clicks the right mouse button on the model map, the size of the circle shape cluster increases by 20% and when researcher moves mouse pointer across the plotting area circle shape cluster moves also in the direction of mouse pointer. Both actions are optional and they are executed only if user wants to do so. Thus there is no starting fix point for clustering. User can move circle shape cluster in any direction and then can increase or decrease the size of cluster to select desired records perfectly.
Figure 4.69 Fifth step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle shape as graphical selector.

(e) When Researcher double clicks left the mouse button

Figure 4.70 Sixth step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle shape as graphical selector.

When researcher double clicks the mouse button, the circular shape cluster is created and the cluster that was sizable & movable earlier becomes fix on the map area. All the records bounded within the circular shape cluster are becomes set of selected records and appears on the data grid area. Enlarged view of Circle shape graphical selector and data grid are displayed below with figure 4.71 and 4.72 respectively. In
Figure 4.71 it can seen clearly that records selected by circle shape graphical cluster are \{54, 6, 78, 4, 68, 24, 58, 23, 50, 63, 59, 28, 72, 60, 42\}. All these selected records are then populated in the data grid when user double clicks the mouse button which can be seen in figure 4.72.
4.6.3 **Key Features of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle as graphical selector.**

- Unlike the previously defined model 4.2, this model makes the use of actual map of Gujarat state as model map instead of plotting area and clustering is performed on the base of longitude and latitude values instead of imaginary x and y coordinates of customer location. Thus model application can be mapped very easily with the real life application.

- Another major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.

- End user gets the flexibility of moving the circular cluster shape across the map area as well as the Circle shape of the cluster can be increased to select desired records as per the end-user conveniences. Thus this model removes the limitation of previous model of moving cluster according to the requirement without fixing starting point of the cluster.

- Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

- End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales selected records are easily accessible from the data grid.

4.6.4 **Limitations of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Circle as graphical selector.**

- Model application only allow to form the cluster in Circular shape only that reduces the flexibility and accuracy of the end user in terms of selection of records.

- If requirement of creating cluster in fractal shape then this model may not be useful as it provides the flexibility of creating cluster only in circular shape.
Also if data is very much clumsy on the map or if dataset is highly dispersed on the map then selection of desired records becomes very difficult and thus resulting in decreased efficiency and less conveniences of the end-user.

After analyzing above define limitation researcher decided to design & develop another model that can provide maximum flexibility in terms of shape of the cluster. Thus researcher design & develop a new Clustering Model to extract plotted data in the form of table by taking a closed fractal shape as graphical selector.

4.7 Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector.

As researcher has decided to design & develop models with actual map and to provide clustering operations with maximum flexibility in terms of shape of cluster and records to be selected, Researcher design & develop a model to extract the plotted data in the form of some table by taking a Fractal shape as graphical selector to create a cluster. Thus Clustering model 4.4 was again designed & developed to extract the plotted data from the map in the form of some table by taking a Fractal shape as graphical selector to create a cluster. Thus following model was designed and the prototype was developed by researcher.

4.7.1 Components of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector.

(a) Fractal_Cluster

It is a main component of the model on which all the other components like model map of Gujarat state, graphical selector, Data Populator and Data Grid are placed.
(b) Cluster Database:

Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created 2 tables (1) Customer table which is used to store the customer’s location in terms of longitude and latitude and from which customers location information are fetched and displayed on the model map (2) Sales table from which records are fetched and displayed in the datagrid which contains the sales transactions carried out with the customers selected by the graphical selector. Here all the records selected by graphical selector are first compared with the field logx(longitude) and laty(latitude) of customer table and their corresponding customer number are stored temporarily into an array and in last these values are compared with the customers number of the sales table and those records whose customer numbers are matched are stored into the data grid. The structure of the Cluster database and both tables as well as records are same as define with table 4.6.2. and 4.6.3 Thus these components are not defined in detail.

(c) Model Map:
Researcher has captured the map of Gujarat state as model map. This map is plotted and used as the component of the model that is used to display all the records of the customer table on the screen. Records are displayed on plotting area at specific top-left values where top is corresponding to the laty (latitude) field value and left is corresponding to the logx (longitude) field value of the specific customer’s location from the customer table [9].

(d) Graphical Selector

Graphical Selector is the component of the model that is used to select records from the model map of Gujarat state. Researcher has provided the way where user can create a fractal shape cluster, For this End-user has to click on the model map where he/she wants to create cluster. The Fractal shape cluster will be drawn as user moves mouse pointer to select and bound records within the bound of the map area. Once user release the left mouse button a line will be automatically drawn between the starting point and the ending points of the cluster. This will create the fractal shape and all the desired records will be bounded by this closed fractal shape.
4.7.2 Development of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector.

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [1,5,7,8].

‘Declaration of global variable and declaration of connection object and recordset object to be used’
Option Explicit
Dim sx, sy, tx, ty, zx, zy As Long
Dim maxx, maxy, minx, miny As Long
Dim i, j, k As Long
Dim t As Integer
Dim cn1 As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim rs9 As ADODB.Recordset
Dim sales() As Variant
Dim rc As Long

‘An event executed when user starts the execution of the program and also used
to open connection-recordset as well as to define the datagrid and shape’
Private Sub Form_Load()
t = 0
rc = 0
Picture1.ForeColor = vbBlue
Set cn1 = New ADODB.Connection
    cn1.CursorLocation = adUseClient
    cn1.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
Set rs1 = New Recordset
    rs1.Open "customer", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdTable
Set rs9 = New Recordset
    rs9.Open "select * from monthly_sales", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdText
msf1.Cols = 5
msf1.Rows = 1
msf1.TextMatrix(0, 0) = "SNO"
msf1.TextMatrix(0, 1) = rs9.Fields(0).Name
msf1.TextMatrix(0, 2) = rs9.Fields(1).Name
msf1.TextMatrix(0, 3) = rs9.Fields(2).Name
msf1.TextMatrix(0, 4) = rs9.Fields(3).Name
End Sub

‘Command button defined as Data Populator, when clicked fetches the data
from database and displays the data on model map of Gujarat State.

Private Sub Command1_Click()
    rc = 0
    Dim LOGP, LATP, CLOG, CLAT As Double
    Dim PX, PY As Long
    LOGP = (68.00537109375 - 75.03662109375) / 640
    LATP = (26.30326423939 - 19.839060009305) / 640
    Picture1.Cls
    rs1.MoveFirst
    While (rs1.EOF <> True)
        ReDim Preserve sales(2, rc)
        CLOG = rs1.Fields(1).Value
        CLAT = rs1.Fields(2).Value
        PX = LOGP + (CLOG - LOGP) * (rc / 10000)
        PY = LATP - (CLAT - LATP) * (rc / 10000)
        msf1.TextMatrix(0, 2 + rc) = PX & " , " & PY
        rc = rc + 1
    Wend
End Sub
CLAT = rs1.Fields(2).Value
PX = ((68.00537109375 - CLOG)) / LOGP
PY = ((26.30326423939 - CLAT)) / LATP
zx = CInt(PX)
zy = CInt(PY)
sales(0, rc) = rs1.Fields(0).Value
sales(1, rc) = zx
sales(2, rc) = zy
rc = rc + 1
Picture1.PSet (zx, zy), vbRed
Picture1.PSet (zx - 1, zy), vbMagenta
Picture1.PSet (zx + 1, zy), vbMagenta
Picture1.PSet (zx, zy + 1), vbMagenta
Picture1.PSet (zx, zy - 1), vbMagenta
Picture1.PSet (zx - 1, zy + 1), vbMagenta
Picture1.PSet (zx + 1, zy + 1), vbMagenta
Picture1.PSet (zx - 1, zy - 1), vbMagenta
Picture1.PSet (zx + 1, zy - 1), vbMagenta
Picture1.ForeColor = vbMagenta
Picture1.Print rs1.Fields(0)
rs1.MoveNext
Wend
Picture1.ForeColor = vbBlue
End Sub

‘An event executed when user clicks left mouse button and starts drawing a fractal shape cluster’

Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
sx = X
sy = Y
tx = X
ty = Y
minx = X
miny = Y
maxx = X
maxy = Y
t = 1
End Sub

‘An event executed when user moves mouse pointer on the model map of Gujarat state to define and draw fractal shape with graphical selector.’

Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
If t = 1 Then
    If minx > X Then
        minx = X
    End If
If miny > Y Then
    miny = Y
End If
If maxx < X Then
    maxx = X
End If
If maxy < Y Then
    maxy = Y
End If
Picture1.Line (tx, ty)-(X, Y)
tx = X
ty = Y
End If
End Sub

‘An event executed when user releases the mouse button it start the fetching of data from the database according to the records selected on the model map of Gujarat state and fill the data grid with this selected records’

Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
Dim LOGP, LATP, CLOG, CLAT As Double
Dim PX, PY, k1 As Long
LOGP = (68.00537109375 - 75.03662109375) / 640
LATP = (26.30326423939 - 19.839060009305) / 640
k = 1
t = 0
Picture1.Enabled = False
Dim flg As Integer
Dim i1, j1 As Long
i1 = 1000
j1 = 1000
Picture1.Line (X, Y)-(sx, sy)
MsgBox ("Please Wait While Result Is Generated")
For j = miny To maxy
    flg = 0
    For i = minx To maxx
        If Picture1.Point(i, j) = vbBlue Then
            If (j = j1 And i = i1 + 1) = False Then
                flg = flg + 1
            End If
            i1 = i
            j1 = j
        End If
    Next i
    If Picture1.Point(i, j) = vbRed Then
        If flg Mod 2 = 1 Then
            msf1.Rows = msf1.Rows + 1
            msf1.TextMatrix(k, 0) = k
            PX = i
            PY = j
        End If
    End If
Next j
End Sub
For k1 = 0 To rc - 1
    If sales(1, k1) = PX And sales(2, k1) = PY Then
        rs9.MoveFirst
        While (rs9.EOF <> True)
            If sales(0, k1) = rs9.Fields(0) Then
                msf1.Rows = msf1.Rows + 1
                msf1.TextMatrix(k, 0) = k
                msf1.TextMatrix(k, 1) = rs9.Fields(0)
                msf1.TextMatrix(k, 2) = rs9.Fields(1)
                msf1.TextMatrix(k, 3) = rs9.Fields(2)
                msf1.TextMatrix(k, 4) = rs9.Fields(3)
                k = k + 1
            End If
        rs9.MoveNext
     Wend
    End If
Next k1
End If
Next i
Next j
End Sub

4.7.3 Steps to implement the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.
When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on the map.

(b) When Data Populator is clicked

When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the model map. The top-left values are corresponding values of the longitude and latitude values of the customer location of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on the map.
(c) When user clicks on model map area and moves mouse pointer

Once user clicks on model map, he/she is allowed to draw or define fractal shape cluster. For such user has to click somewhere on plotting area near to one of the records he/she wants to bound within cluster and then wherever user move mouse pointer fractal shape will be drawn accordingly. Thus user has to move mouse pointer in such a way so that his/her desired records can be selected within the bound of fractal cluster. Figures 4.78 and figure 4.79 shows that wherever user moves mouse pointer, fractal shape is drawn accordingly. Thus user can create the cluster of any shape and that gives the maximum flexibility to user to select all the desired records within the bound of fractal cluster. Only care has to be taken by end user is that he/she has to draw a fractal in such a way so that all the desired records comes within the fractal shape and starting point of the cluster and the ending point at which user is going to release the mouse button must be nearer so that user can get the 100% perfection in terms of selection of records. For example if user want to cluster records with customer_no= {6,73,4,68,24,58,23,70,50,63,59,72,60} and if user release the mouse at end point as define in figure 4.78 then customer_no 23,4,70 may not be cluster or bound within the fractal shape cluster as there will be a line automatically drawn from ending point to the starting point. Instead of that if user draw a fractal like defined in figure 4.79 then all the desired records will be bound and selected within the closed fractal shape cluster.
Figure 4.78 Third step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal shape as graphical selector.

(d) When user is about to release the mouse button

Figure 4.79 Fourth (Optional) step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal shape as graphical selector.
(f) **When user release the mouse button**

When user releases the mouse button immediately a line is drawn between the starting point and ending point of cluster and thus forming close end cluster. All the records bounded within the fractal shape cluster becomes set of selected records and appears on the data grid area.

![Figure 4.80](image)

**Figure 4.80** Fifth step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal shape as graphical selector.

Enlarged view of model map area & graphical selector (Figure 4.81) and data grid (Figure 4.82) are described below which clearly states that those records selected by the user with the fractal shape graphical selectors appears in the data grid. Figure 4.81 shows that user has selected / bounded the customers with customer_no= {6,73,4,68,24,58,23,70,50,63,59,72,60}. Figure 4.82 shows the enlarged view of data grid that clearly shows that all the records selected by fractal shape cluster are appearing in the data grid.
Figure 4.81 Enlarged view of plotting area and graphical selector of figure 4.80

Figure 4.82 Enlarged view of plotting area and graphical selector of figure 4.80
4.7.4 Key Features of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector.

- Unlike the previously defined model 4.4, this model makes the use of actual map of Gujarat state as model map instead of plotting area and clustering is performed on the base of longitude and latitude values instead of imaginary x and y coordinates of customer location. Thus model application can be mapped very easily with the real life application.
- The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.
- Unlike previous models it is not compulsory to have rectangle shape or circular shape for clustering. With utmost flexibility user can draw a cluster that covers or bound 100% desired records with the fractal shape. Thus end user is getting the flexibility of drawing any shape of cluster as model allows to form the cluster as user moves mouse pointer on the model map of Gujarat state. Thus not restricted with circular, rectangle or any other shape and thus removes the limitation of previous models. User can define a cluster in a way so that 100% of desired records can be bounded or can be selected to be clustered.
- Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.
- End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales as selected records are easily accessible from the data.

4.7.5 Limitations of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector.

- If model map area is clumsy with the records then it becomes very difficult to select desire records and distinguish the records to be clustered and records not to be clustered.
Also if map area is heavily populated by the records and becomes clumsy then accuracy in terms of selection of desired records degraded as it becomes very difficult for the end user to draw a fractal shape cluster to select records.

If facility of enlarging map area is provided then it creates another problem where most of the enlarged map area may not be visible and there is no facility to move the map area is provided and thus may not be possible to select desired records.

After analyzing above define limitation researcher decided to design & develop another model that can provide maximum flexibility in terms of shape of the cluster. As well as researcher decided to design & develop a new Clustering Model that provides the facility of enlargement of model map area to select the records and the facility to navigate the model map area within the navigation area. Thus researcher design and develop a model to extract plotted data in the form of table by taking a closed fractal shape as graphical selector and with zoom-in, zoom-out facility to perfectly select records in case of clumsy data as well as with navigation of model map area.

4.8 Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

As researcher has decided to design & develop models with actual map that can provide clustering operations with maximum flexibility in terms of shape of cluster for records to be selected, to provide the better & perfect selection of records in case of clumsy or highly dispersed data and also to provide navigation facility in case of zoomed and shrink plotting area, Researcher design & develop a model to extract the plotted data in the form of some table by taking a Fractal shape as graphical selector with zoom-in, zoom-out and navigation facility to create a cluster. Thus Clustering model 4.5 was again designed & developed to fulfill requirements specified above in section 4.1.

4.8.1 Components of the Clustering Model to extract plotted data from the actual map in the form of table by taking Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(a) Fractal_Cluster_With_Zoom_With_Navigation
It is a main component of the model on which all the other components like Plotting area, Graphical selector, Navigation_Area, Zoom-In, Zoom-Out, Lock_Zoom, Data Populator, Data Grid, Total Sales and Average Sales are placed.

(b) Cluster Database:
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created 2 tables (1) Customer table which is used to store the customer’s location in terms of longitude and latitude and from which customers location information are fetched and displayed on the model map (2) Sales table from which records are fetched and displayed in the datagrid which contains the sales transactions carried out with the customers selected by the graphical selector. Here all the records selected by graphical selector are first compared with the field logx(longitude) and laty(latitude) of customer table and their corresponding customer number are stored temporarily into an array and in last these values are compared with the customers number of the sales table and those records whose customer numbers are matched are stored into the data grid. The structure of the Cluster database and both tables as well as records are same as define with table 4.6.2 and 4.6.3 Thus these components are not defined in detail.
(c) Model Map:

Figure 4.84 Model map, the component Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

Researcher has captured the map of Gujarat state as model map. This map is plotted and used as the component of the model that is used to display all the records of the customer table on the screen. Records are displayed on plotting area at specific top-left values where top is corresponding to the laty (latitude) field value and left is corresponding to the logx (longitude) field value of the specific customer’s location from the customer table.

(d) Navigation area

Navigation area is the component of the model that allows to move model map area within the bound of itself. Whenever user enlarges or shrink the size of model map area to perfectly select the records, at that time user can navigate the mode map area within the bound of navigation area.
Figure 4.85 Navigation Area, the main component of Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(e) Graphical Selector

Figure 4.86 Graphical Selector, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.
Graphical Selector is the component of the model that is used to select records from the model map of Gujarat state. Researcher has provided the way where user can create a fractal shape cluster, for this End-user has to click on the model map area where he/she wants to create cluster. The Fractal shape cluster will be drawn as user moves mouse pointer to select and bound records within the model map area. Once user release the left mouse button a line will be automatically drawn between the starting point and the ending points of the cluster. This will create the fractal shape and all the desired records will be bounded by this closed fractal shape.

(f) Zoom In
This component is used to enlarge or zoom the map area by 200%. When-ever map are is clumsy and user wants to distinguish between records to be selected and records not to be selected, then user clicks on this zoom_in button so that all the desirable records can be selected perfectly.

![Zoom_In](image)

Figure 4.87 Zoom_In, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(g) Zoom_Out
This component is used to shrink or zoom out the map area by 50%. Whenever maximum part of the map area is to be clustered then it may be difficult to select all the desirable records within the fractal cluster. At that time user can shrink or zoom out the plotting area by clicking this component.

![Zoom_Out](image)

Figure 4.88 Zoom_Out, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(h) Lock_Zoom
This component is used to disable the zoom-in and zoom-out and to disable the navigation of plotting area. Once the plotting area is perfectly visible, user has to click this component to disable the zooming process and navigation process of
plotting area, so that plotting area remain as it is when user draw a cluster on the plotting area.

Figure 4.89 Lock_Zoom, the component of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(i) Data Populator

The design and the functionality of this component is as same as the component of model 4.5.1 (e) Data Populator. Thus it is not redefine over here.

(j) Data Grid

The design and the functionality of this component is as same as the component of model 4.5.1 (f) Data Grid. Thus it is not redefine over here.

4.8.2 Development of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

To develop a program for above describe model researcher has written the code in VB 6.0 which is define below [2,3,7,8].

```vbnet
'Declaration of global variable and declaration of connection object and recordset object to be used'
Option Explicit
Private Const HALFTONE As Long = 4
    Private Declare Function StretchBlt Lib "gdi32" (ByVal hdc As Long, _
        ByVal x As Long, _
        ByVal y As Long, _
        ByVal nWidth As Long, _
        ByVal nHeight As Long, _
        ByVal hSrcDC As Long, _
        ByVal xSrc As Long, _
        ByVal ySrc As Long, _
        ByVal nSrcWidth As Long, _
        ByVal nSrcHeight As Long, _
        ByVal dwRop As Long) As Long
    Private Declare Function SetStretchBltMode Lib "gdi32" (ByVal hdc As Long, _
        ByVal nStretchMode As Long) As Long
    Dim sx, sy, tx, ty As Long
```
Dim ZX, ZY As Double
Dim maxx, maxy, minx, miny As Long
Dim ax, ay, bx, by As Long
Dim i, j, k, rc As Long
Dim Z, t, m, op As Integer
Dim sales() As Variant
Dim cn1 As ADODB.Connection
Dim rs1 As ADODB.Recordset
Dim rs9 As ADODB.Recordset

‘An event executed when user starts the execution of the program and also used to open connection-recordset as well as to define the datagrid.’
Private Sub Form_Load()
t = 0
Z = 1
op = 0
rc = 0
Picture1.ForeColor = vbBlue
Set cn1 = New ADODB.Connection
    cn1.CursorLocation = adUseClient
    cn1.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=cluster.mdb;Persist Security Info=False"
Set rs1 = New Recordset
    rs1.Open "customer", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdTable
Set rs9 = New Recordset
    rs9.Open "select * from monthly_sales", cn1, adOpenDynamic, adLockBatchOptimistic, adCmdText
msf1.Cols = 5
msf1.Rows = 1
msf1.TextMatrix(0, 0) = "SNO"
msf1.TextMatrix(0, 1) = rs9.Fields(0).Name
msf1.TextMatrix(0, 2) = rs9.Fields(1).Name
msf1.TextMatrix(0, 3) = rs9.Fields(2).Name
msf1.TextMatrix(0, 4) = rs9.Fields(3).Name
End Sub

‘Command button defined as Data Populator, when clicked fetches the data from database and displays the data on plotting area.
Private Sub Command1_Click()
    rc = 0
    'new code inserted from here
    Dim LOGP, LATP, CLOG, CLAT As Double
    Dim PX, PY As Long
    LOGP = (68.00537109375 - 75.03662109375) / 640
    LATP = (26.30326423939 - 19.839060009305) / 640
    'new code completed here
    Picture1.Cls
    rs1.MoveFirst
    Picture1.ForeColor = vbRed
    While (rs1.EOF <> True)
ReDim Preserve sales(2, rc)
CLOG = rs1.Fields(1).Value
CLAT = rs1.Fields(2).Value
PX = ((68.00537109375 - CLOG)) / LOGP
PY = ((26.30326423939 - CLAT)) / LATP
ZX = Int(PX)
ZY = Int(PY)
sales(0, rc) = rs1.Fields(0).Value
sales(1, rc) = ZX
sales(2, rc) = ZY
rc = rc + 1
ZX = ZX * Z
ZY = ZY * Z
ZX = Int(ZX)
ZY = Int(ZY)
Picture1.PSet (ZX, ZY), vbRed
Picture1.PSet (ZX - 1, ZY), vbMagenta
Picture1.PSet (ZX + 1, ZY), vbMagenta
Picture1.PSet (ZX, ZY + 1), vbMagenta
Picture1.PSet (ZX, ZY - 1), vbMagenta
Picture1.ForeColor = vbMagenta
Picture1.Print rs1.Fields(0)
rs1.MoveNext
Wend
Picture1.ForeColor = vbBlue
End Sub

‘An event executed when user clicks lock_zoom button disable the zooming process and navigation process and wants to start drawing a fractal shape cluster’
Private Sub Command2_Click()
op = 1
End Sub

‘An event executed automatically whenever user performs zoom-in or zoom-out operations at that time to maintain the resolution and visibility it calls the zoomprocess.
Private Sub Form_Activate()
Call ZOOMPROCESS
End Sub

‘An event executed when user clicks left mouse button and starts drawing a fractal shape cluster’
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, x As Single, y As Single)
If op = 1 Then
   sx = x
   sy = y
   tx = x
   ty = y
End Sub
minx = x
miny = y
maxx = x
maxy = y
t = 1
Else
    ax = x
    ay = y
End If
End Sub

‘An event executed when user moves mouse pointer on the plotting area to define
and draw fractal shape with graphical selector.’
Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, x As Single, y As Single)
If op = 1 Then
    If t = 1 Then
        If minx > x Then
            minx = x
        End If
        If miny > y Then
            miny = y
        End If
        If maxx < x Then
            maxx = x
        End If
        If maxy < y Then
            maxy = y
        End If
        Picture1.Line (tx, ty)-(x, y)
        tx = x
        ty = y
    End If
End If
End If
End Sub

‘An event executed when user releases the mouse button it start the fetching of
data from the database according to the records selected on the plotting area and
fill the data grid with this selected records’
Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, x As Single, y As Single)
Dim LOGP, LATP, CLOG, CLAT As Double
Dim PX, PY, k1 As Long
LOGP = (68.00537109375 - 75.03662109375) / 640
LATP = (26.30326423939 - 19.839060009305) / 640
If op = 1 Then
    t = 0
    k = 1
Picture1.Enabled = False
Dim flg As Integer
Dim i1, j1 As Long
i1 = 1000
j1 = 1000
Picture1.Line (x, y)-(sx, sy)
MsgBox ("Please Wait While Result Is Generated")
For j = miny To maxy
    flg = 0
    For i = minx To maxx
        If Picture1.Point(i, j) = vbBlue Then
            If (j = j1 And i = i1 + 1) = False Then
                flg = flg + 1
            End If
        End If
        i1 = i
        j1 = j
    Next i
    If Picture1.Point(i, j) = vbRed Then
        If flg Mod 2 = 1 Then
            msf1.Rows = msf1.Rows + 1
            msf1.TextMatrix(k, 0) = k
            PX = i / Z
            PY = j / Z
            MsgBox (PX & "----" & PY)
        End If
        For k1 = 0 To rc - 1
            If sales(1, k1) = PX And sales(2, k1) = PY Then
                rs9.MoveFirst
                While (rs9.EOF <> True)
                    If sales(0, k1) = rs9.Fields(0) Then
                        msf1.Rows = msf1.Rows + 1
                        msf1.TextMatrix(k, 0) = k
                        msf1.TextMatrix(k, 1) = rs9.Fields(0)
                        msf1.TextMatrix(k, 2) = rs9.Fields(1)
                        msf1.TextMatrix(k, 3) = rs9.Fields(2)
                        msf1.TextMatrix(k, 4) = rs9.Fields(3)
                        k = k + 1
                    End If
                rs9.MoveNext
            End If
        Next k1
    End If
Next j
Else
    bx = x
    by = y
    Picture1.Top = Picture1.Top + by - ay
    Picture1.Left = Picture1.Left + bx - ax
Call Command1_Click
End If
End Sub

‘An event executed when user clicks this button to enlarge or to zoom-in plotting area so that desired records can be visible easily and selected perfectly.
Private Sub ZOOMIN_Click()
Z = Z * 2
'zoom in by 200%
  With Picture1
    .Move 0, 0, .Width * 2, .Height * 2
    .Cls
    StretchBlt .hdc, 0, 0, .ScaleWidth, .ScaleHeight, Picture2.hdc, 0, 0, _
    Picture2.ScaleWidth, Picture2.ScaleHeight, vbSrcCopy
  End With 'Picture1
  Picture1.Picture = Picture1.Image
  Call Command1_Click
End Sub

‘An event executed when user clicks this button to shrink or to zoom-out plotting area in case were desired records are highly dispersed and user wants to bound or select all these records
Private Sub ZOOMOUT_Click()
Z = Z / 2
'zoom out by 200%
  With Picture1
    .Move 0, 0, .Width / 2, .Height / 2
    .Cls
    StretchBlt .hdc, 0, 0, .ScaleWidth, .ScaleHeight, Picture2.hdc, 0, 0, _
    Picture2.ScaleWidth, Picture2.ScaleHeight, vbSrcCopy
  End With 'Picture1
  Picture1.Picture = Picture1.Image
  Call Command1_Click
End Sub

‘An event executed whenever the main component of the model is resized or whenever the zoom-in and zoom-out process is executed. This event is special event used to maintain the resolution quality of the plotting area whenever user performs zoom-in or zoom-out process.
Private Sub ZOOMPROCESS()
Picture2.PaintPicture Picture1.Picture, 0, 0, Picture1.ScaleWidth, Picture1.ScaleHeight
Picture2.Picture = Picture2.Image
  With Picture2 'source
    .AutoRedraw = True
    .ScaleMode = vbPixels
    .Visible = False
    '.AutoSize = True 'use if loading a graphic
    'Picture2.Print "Picture 222222Box Text"
    'or .Picture = LoadPicture("c:\somefolder\somegraphic.bmp")
  End With
With Picture1 'dest
'I've heard this improves quality
SetStretchBltMode hdc, HALFTONE
.AutoRedraw = True
.ScaleMode = vbPixels
.Move 0, 0, Picture2.Width, Picture2.Height
.Picture = Picture2.Image
'Picture1.Print "Some Picture 11111111Box Text"
End With
End Sub

4.8.3 Steps to implement the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.

Figure 4.90 First step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

When researcher executes the program the above define layout appears on the screen. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on model map area.
(b) When Data Populator is clicked
When researcher clicks on the Data Populator, all the record from the cluster database are is fetched and customer_no is displayed at respective top-left position on the model map. The top-left values are corresponding values of the longitude and latitude values of the customer location of the cluster database. Graphical selector does not appear on the screen until and unless user clicks on the map.

![Image of the Data Populator and model map with the Data Populator button highlighted.](image)

Figure 4.91 Second step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(c) When user clicks on zoom-out component and moves mouse pointer
When user clicks on zoom-out the map area height and width decreases by 50% and map area reduced by 75%. This step is optional step and executed by user when he/she wants to include most of the plotted records within the bound of cluster. User can increase /decrease the size of map area until and unless lock_zoom component is clicked.
(d) *When user clicks on map area and drag map area.* *(After Zoom-In)*

This step is optional step and executed by the user for better view and selection user may want to move map area within the bound of navigation area. For such user can click and drag map area in the desired direction and location. User can move map area until and unless lock_zoom component is clicked.

(e) *When user clicks on zoom-In component*
Figure 4.94 Fifth (Optional) step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

When user clicks on zoom-In the map areas height and width increased by 100% and map area is increased by 400%. This step is optional step and executed by user when map area is very much clumsy with the records and user wants to perfectly select the records from the map area within the bound of fractal shape. User can increase /decrease the size of map area until and unless lock_zoom component is clicked.

**(f) When user clicks and drag map area (After Zoom-In).**

Once user clicks on zoom-in the size of the map area will be increased by 400%. Thus whole map area may not be visible and hence all the desired records may not be visible. Thus in such case user may require to navigate map area in such a way so that all the desired records may become visible. User can move map area until and unless lock_zoom component is clicked. Following figure 4.95 describes that map area has been navigated towards the right-bottom direction by clicking mouse pointer on map area and dragging it towards the bottom-right direction. Figure 4.96 indicates that map area has been navigated towards the top-left direction by clicking mouse pointer on map area and dragging it towards the top-left direction. Thus whenever map area is zoomed in and whenever desired part of map area is not visible, User can make it visible by clicking and dragging map area.
Figure 4.95 Sixth (Optional) step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

Figure 4.96 Seventh (Optional) step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(g) When user clicks on Lock_Zoom Component.

After navigation once the map area with desired records is visible, User clicks on Lock_zoom component that disables the Zoom_In, Zoom_out and navigation process of map area. To draw fractal shape cluster it is compulsory to disable these processes as map area keeps on navigation whenever user clicks and drag mouse button on map.
area. Thus creation of fractal cluster will only start after disabling the zooming and navigation process.

Figure 4.97 Eighth step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

(h) When user clicks on plotting area to draw cluster

Once user clicks on map area, he/she is allowed to draw or define fractal shape cluster. For such user has to click somewhere on map area near to one of the records he/she wants to bound within cluster and then wherever user move mouse pointer fractal shape will be drawn accordingly. Thus user has to move mouse pointer in such a way so that his/her desired records can be selected within the bound of fractal cluster. Figures 4.98 and figure 4.99 shows that wherever user moves mouse pointer, fractal shape is drawn accordingly. Thus user can create the cluster of any shape and that gives the maximum flexibility to user to select all the desired records within the bound of fractal cluster. Only care has to be taken by end user is that he/she has to draw a fractal in such a way so that all the desired records comes within the fractal shape and starting point of the cluster and the ending point at which user is going to release the mouse button must be nearer so that user can get the 100% perfection in terms of selection of records. For example if user want to cluster records with customer_no= {73,4,80,68,24,58,23,50,63,59,28,48,72} and if user release the mouse at end point as define in figure 4.98 then customer_no 4,80 may not be cluster or bound within the fractal shape cluster as there will be a line automatically drawn from ending point to the starting point. Instead of that if user draw a fractal like defined in
figure 4.99 then all the desired records will be bound and selected within the closed fractal shape cluster.

![Figure 4.98](image)

**Figure 4.98** Ninth step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

![Figure 4.99](image)

**Figure 4.99** Tenth (Optional) step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(i) **When user release the mouse button**

When user releases the mouse button immediately a line is drawn between the starting point and ending point of cluster and thus forming close end cluster. All the records
bounded within the fractal shape cluster becomes set of selected records and appears on the data grid area. Enlarged view of map area & graphical selector (Figure 4.101) and data grid (Figure 4.102) are described below which clearly states that those records selected by the user with the fractal shape graphical selectors appears in the data grid.

Figure 4.100 Eleventh (optional) step of implementation of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility

Figure 4.101 Enlarged view of model map area and graphical selector of figure 4.100
4.8.4 **Key Features of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.**

- Unlike the previously defined model 4.5, this model makes the use of actual map of Gujarat state as model map instead of plotting area and clustering is performed on the base of longitude and latitude values instead of imaginary x and y coordinates of customer location. Thus model application can be mapped very easily with the real life application.

- The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.
This model eliminates the limitation of previous model 4.9 in case of clumsy data on model map area by providing the facility of zoom-in and zoom-out of the plotting area and navigation of map area. End user can get the enlarged view of model map area as per the requirement by clicking zoom-in component. Also to make visible all the records when model map area is enlarged, navigation facility is provided. Thus user can enlarge the model map area as to make the model map area best visible and then navigate model map area as per the requirement to perfectly select the desired records.

This model also eliminates the limitation of previous model 4.9 in case of requirement of selection of large area within the bound of cluster. For this model map area is required to be shrink. This facility is provided with the zoom-out control with which user can decrease the size of model map area as per the requirement and then allow to navigate model map area to perfectly select the records to create fractal cluster.

End user is getting the flexibility of drawing any shape of cluster as model allows to form the cluster as user moves mouse pointer on the model map area. Thus not restricted with circular, rectangle or any other shape and thus removes the limitation of previous models. User can define a cluster in a way so that 100% of desired records can be bounded or can be selected to be clustered.

Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales as selected records are easily accessible from the data grid.

4.8.5 Limitations of the Clustering Model to extract plotted data from the actual map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

It is not necessary that user always want to perform clustering on the model map area of Gujarat state. On different access user may want to perform
clustering on different area, different cities, different districts or even user may want to perform clustering on area which is not provided in the model map of Gujarat state, which may be the area of other state or districts, cities of other states. But with model application only mp of Gujarat state can be used, thus reduces the flexibility of the user to select desired area and to perform clustering on it.

- Every time when user select different area of map, it is require that user has to acquire the image of the map of size 640 * 640 pixels and its corresponding top-left and bottom-right corner longitude and latitude and to change such longitude and latitude value in the model application.

- Also the map has to be placed very accurately on the plotting area of the application at every time when ever user wants to perform the clustering on different maps of different area.

- It is very difficult for End-user or decision maker to perform all the above tasks to use this model for analysis purpose.

After analyzing above define limitations and problems researcher decided to design & develop model where user can acquire the map of desired region or area and its corresponding longitude and latitude automatically from the online Google map application instead of acquiring the image of map and its corresponding longitude and latitude values manually. Thus model application 4.11 was designed & developed to provide the desired functionality and to eliminate above define limitation of the model application.

4.9 Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

As researcher has decided to design & develop models that can provide clustering operations with maximum flexibility in terms of selection of any region/geographical area (not bounded to any city, state or country), also in terms of shape of cluster for records to be selected, also to provide the better & perfect selection of records in case of clumsy or highly dispersed data and also to provide navigation facility in case of zoomed and shrink plotting area. Thus to cater above define functionality Researcher design & develop a model with online, navigational and sizable map to extract the
plotted data in the form of some table by taking a Fractal shape as graphical selector with zoom-in, zoom-out and navigation facility to create a cluster.

4.9.1 Components of the Clustering Model to extract plotted data from the actual map in the form of table by taking Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(a) Online Map Control

It is one of the two main components of the model that provides the facility of selecting map of any geographical area. User can navigate and visualize any region, city, state or country by dragging mouse in the specific direction. Also any geographical area can be viewed in enlarged form by double clicking left mouse button on the map that allows user to focus on smallest possible region on the map. Any geographical area can be viewed in shrunk form by double clicking right mouse button on the map that allows user to cover largest possible region on the map. As and when user navigate through the map, the respective longitude and latitude of top-left corner, bottom-right corner and center point of the map are displayed with the respective label aligned on the right hand side of the map [9].

(b) Enlarged view of Online Map
Figure 4.104 Enlarged view of Online of figure 4.103 with the longitude, latitude of top-left and bottom-right corner of the currently selected region.

(c) Enlarged view of labels with longitude and latitude values

```plaintext
Left-Top X Logitude: 68.988647460938
Left-Top Y Latitude: 24.021379342900
Right-Bottom X Logitude: 72.504272460938
Right-Bottom Y Latitude: 20.771523019513
Center X Logitude: 70.746459960938
Center Y Latitude: 22.396451181207
```

Figure 4.105 Enlarged view of Longitude and Latitude of top-left, bottom-right corner and center point of the currently selected map of figure 4.103

(d) Enlarged view of Map_Locker
Once user selects the desired geographical area from the map, Map_Locker control is clicked to set the map constant on the screen to perform some data mining tasks. Once user clicks on this button control is transferred to another application with cropped / desired geographical area’s map with its respective top-left, bottom-right corner longitude and latitude.

![Map_Locker control](image1)

**Figure 4.106 Enlarged view Map_Locker control of figure 4.103**

**Fractal_Cluster_With_Zoom_With_Navigation_With_Selected_Map**  
It is a main component of the model on which all the other components like User defined & selected geographical area’s map, labels for Top-Left & Bottom-Right corner Longitude & Latitude, Plotting area, Graphical selector, Navigation_Area, Zoom-In, Zoom-Out, Lock_Zoom, Data Populator, Data Grid are placed.

![Fractal_Cluster_with_Zoom_with_Navigation_with_Selected_Map](image2)

**Figure 4.107 Fractal_Cluster_with_Zoom_with_Navigation_with_Selected_Map, the 2nd main component of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.**

**Cluster Database:**  
Researcher created a Cluster Database as sample database to store the data related to clustering activities. Here researcher has created 2 tables (1) Customer table which is
used to store the customer’s location in terms of longitude and latitude and from which customers location information are fetched and displayed on the model map (2) Sales table from which records are fetched and displayed in the datagrid which contains the sales transactions carried out with the customers selected by the graphical selector. Here all the records selected by graphical selector are first compared with the field logx(longitude) and laty(latitude) of customer table and their corresponding customer number are stored temporarily into an array and in last these values are compared with the customers number of the sales table and those records whose customer numbers are matched are stored into the data grid. The structure of the Cluster database and both tables as well as records are same as define with table 4.6.2. and 4.6.3 Thus these components are not defined in detail.

(g) User defined & captured geographical area’s map:

![User defined and captured map](Image)

Figure 4.108 User defined and captured map, A component of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility. Researcher has captured the map from online map component. This map is plotted and used as the component of the model that is used to display all the records of the customer table on the screen. Records are displayed on plotting area at specific top-
left values where top is corresponding to the laty (latitude) field value and left is corresponding to the logx (longitude) field value of the specific customer’s location from the customer table [9].

(h) Navigation area
This component is as same as defined with model 10.4.2 (d) Navigation area in terms of functionality and characteristics. Thus not redefined here.

(i) Graphical Selector
This component is as same as defined with model 10.4.2 (e) Graphical Selector in terms of functionality and characteristics. Thus not redefined here.

(j) Zoom_In
This component is as same as defined with model 10.4.2 (f) Zoom_In in terms of functionality and characteristics. Thus not redefined here.

(k) Zoom_Out
This component is as same as defined with model 10.4.2 (g) Zoom_Out in terms of functionality and characteristics. Thus not redefined here.

(l) Lock_Zoom
This component is as same as defined with model 10.4.2 (h) Lock_Zoom in terms of functionality and characteristics. Thus not redefined here.

(m) Data Populator
This component is as same as defined with model 10.4.2 (i) Data Populator in terms of functionality and characteristics. Thus not redefined here.

(k) Data Grid
This component is as same as defined with model 10.4.2 (j) Data Grid in terms of functionality and characteristics. Thus not redefined here.

4.9.2 Development of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a
Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

The development of the model is divided into 3 parts (forms) connected with each other. They are as follows.

(1) **Online Map**

(2) **Screen Capture Form**

(3) **Fractal Cluster Form**

(1) **Online Map (dsgmap.html file):**

Researcher has used Google Map V2 API embedded with the html, JavaScript file and modified according to the model’s requirement and as researcher wants to allow to capture any geographical area’s map for the clustering [9].

**Declaration and initialization of various tags and variables to be used of global variable and declaration of connection object and recordset object to be used**

```html
<html xmlns="http://www.w3.org/1999/xhtml"
xmlns:v="urn:schemas-microsoft-com:vml">
<head>
<meta http-equiv="content-type" content="text/html; charset=UTF-8"/>
<title>Google Maps</title>
<script src="http://maps.google.com/maps?file=api&v=2&amp;
key=ABQIAAAAjU0EJWnWPMv7oQ-jjS7dYxSPW5CJgpdgO_s4yyMovOaV-h_KvvhSfpvagV18cOyDcWu7VytS6Bi1CWxw"
type="text/javascript"></script>
<script type="text/javascript">
var map = null;
var geocoder = null;

function initialize() {
    if (GBrowserIsCompatible()) {
        map = new GMap2(document.getElementById("map_canvas"));
        map.setCenter(new GLatLng(22.303895,70.80216), 12);
        geocoder = new GClientGeocoder();
    }
}

Process defines the initial geographical area to be displayed when and where from map is to be captured

Process defines the map of geographical area to be displayed when and where from map is to be captured
function showAddress(address) {
    if (geocoder) {
        geocoder.getLatLng(address,
            function(point) {
                if (!point) {
                    alert(address + " not found");
                } else {
                    map.setCenter(point, 15);
                    var marker = new GMarker(point, {draggable: true});
                    GEvent.addListener(marker, "dragend", function() {
                        marker.openInfoWindowHtml(marker.getLatLng().toUrlValue(12));
                    });
                    GEvent.addListener(marker, "click", function() {
                        marker.openInfoWindowHtml(marker.getLatLng().toUrlValue(12));
                    });
                    GEvent.trigger(marker, "click");
                }
            }
        );
    }
}

Event is executed when user drags the mouse to navigate towards the desired geographical area on the map and double click to enlarge or shrink the geographical area displayed on the map.

Function is used to get the value of top-left corner, bottom-right corner longitude and latitude when user drags the mouse to navigate towards the desired geographical area on the map and double click to enlarge or shrink the geographical area displayed on the map.

function gettopbottom()
{
    x=map.getBounds();
    xy=x.getSouthWest();
    yx=x.getNorthEast();
    var nwlngx=xy.lng().toFixed(12);
    var nwlaty=yx.lat().toFixed(12);
    var selngx=yx.lng().toFixed(12);
    var selaty=xy.lat().toFixed(12);
    c=x.getCenter();
    var clngx=c.lng().toFixed(12);
    var claty=c.lat().toFixed(12);
    document.getElementById("lefttoplong").value=nwlngx;
    document.getElementById("rightbottomlat").value=nwlaty;
    document.getElementById("rightbottomlong").value=selngx;
    document.getElementById("lefttoplat").value=selaty;
    document.getElementById("centerlong").value=clngx;
    document.getElementById("centerlat").value=claty;
}

</script>     </head>
Declaration and initialization of body part of the web page, various tags and variables to be used to display the online map and its respective top-left corner, bottom-right corner longitude and latitude values.

```html
<body onload="initialize()" onunload="GUnload()">
    <form action="#" onsubmit="showAddress(this.address.value); gettopbottom(); return false">
        <table border="0">
            <tr>
                <td>
                    <div id="map_canvas" style="width: 640px; height: 640px;margin: -11px 0 0 -10px;" onmouseup="gettopbottom()"></div>
                </td>
                <td valign="top">
                    Left-Top X Longitude <input type="text" id="lefttoplong" name="lefttoplong" value="" /> <br />
                    Left-Top Y Latitude <input type="text" id="rightbottomlat" name="rightbottomlat" value="" /> <br />
                    Right-Bottom X Longitude <input type="text" id="rightbottomlong" name="rightbottomlong" value="" /> <br />
                    Right-Bottom Y Latitude <input type="text" id="lefttoplat" name="lefttoplat" value="" /> <br />
                    Center X Longitude <input type="text" id="centerlong" name="centerlong" value="" /> <br />
                    Center Y Latitude <input type="text" id="centerlat" name="centerlat" value="" />
                </td>
            </tr>
        </table>
    </form>
</body>
</html>

(2) Screen Capture Form (FormScreenCapture.frm)

This form is used to capture and permanently set the geographical area on the map from the online map. This form contains Browser Activex Control to display the online Map with the Visual Basic Form [3,4,7,8]. Also this form contains various API calls of Visual Basic application to handle the graphical operation.

'This call gives us the hWnd (window handle) of the screen
Private Declare Function GetDesktopWindow Lib "user32" () As Long

'This call assigns an hDC (handle of device context) from an hWnd
Private Declare Function GetDC Lib "user32" (ByVal hWnd As Long) As Long

'This call takes an hDC and converts it to a compatible bitmap format
Private Declare Function CreateCompatibleBitmap Lib "gdi32" (ByVal hdc As Long, ByVal nWidth As Long, ByVal nHeight As Long) As Long

' This call BitBlt allows to draw an image from a hDC to another hDC (in our case, from an hDC of the screen capture to the hDC of a VB picture box)
Private Declare Function BitBlt Lib "gdi32" (ByVal hdc As Long, ByVal x As Long, ByVal y As Long, ByVal nWidth As Long, ByVal nHeight As Long, ByVal hSrcDC As Long, ByVal xSrc As Long, ByVal ySrc As Long, ByVal opCode As Long) As Long

' This call DeleteObject will be used to delete the hWnd we generate - it's polite to free up the memory once we're done with it
Private Declare Function DeleteObject Lib "gdi32" (ByVal hObject As Long) As Long

' This call ReleaseDC will be used to clear out the hDC we generate for the screen capture.
Private Declare Function ReleaseDC Lib "user32" (ByVal hWnd As Long, ByVal hdc As Long) As Long

' This event is executed when user decide to capture the specific geographical area from the online map and wants to set the map permanently on the Fractal Cluster application for clustering process

Private Sub Command1_Click()
    ' Get the hWnd of the screen
    Dim scrHwnd As Long
    scrHwnd = GetDesktopWindow

    ' Now, assign an hDC to the hWnd we generated
    Dim shDC As Long
    shDC = GetDC(scrHwnd)

    ' Determine the size of the screen
    Dim screenWidth As Long, screenHeight As Long
    screenWidth = Screen.Width \ Screen.TwipsPerPixelX
    screenHeight = Screen.Height \ Screen.TwipsPerPixelY

    ' Convert this new hDC into bitmap format
    CreateCompatibleBitmap shDC, screenWidth, screenHeight

    ' Copy the data from the new bitmap-compatible hDC to this VB form
    BitBlt FormScreenCapture.hdc, 0, 0, 642, 642, shDC, 0, 0, vbSrcCopy

    ' Set the picture of the form to equal its image
    FormScreenCapture.Picture = FormScreenCapture.Image
    Picture1.Picture = FormScreenCapture.Image
    Me.WindowState = vbNormal
Mainform.PictureBox1.Picture = Picture1.Picture

'Free up the memory we used to generate the screen capture
ReleaseDC scrHwnd, shDC
DeleteObject shDC
Me.Hide

' To set the top-left corner, bottom-right corner longitude and latitude value at the Fractal Cluster Form (Mainform.frm) and to move control from Screen Capture Form to Fractal Cluster Form.
Mainform.l2.Caption = (wb1.Document.GetElementById("rightbottomlat").Value)
Mainform.Show
End Sub

‘This event is responsible to display the online map in form of dsgmap.html file in the current form (ScreenCaptureForm.frm).
Private Sub Form_Load()
   wb1.Navigate (App.Path + "/dsgmap.html")
End Sub

(3) Fractal Cluster Form (Mainform.frm)
This form contains all the events, functions and the coding which is as same as define with the model 4.10.3. Thus coding of this form is not redefined here.

4.9.3 Steps to implement the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility & Result Discussion.

To implement the model researcher has executed the above define program integrated with above define components and thus the model was implemented into the several steps as per the following.

(a) When researcher starts the execution of the program following screen appears first.
Figure 4.109 First step of implementation of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

When researcher executes the program the above define layout appears on the screen. Components like Online Map, Labels with top-left corner, bottom-right corner and center points longitude and latitude values and command button to lock and permanently set the map appears on the screen initially.

(b) When researcher navigates through the map (Optional)

This step is optional it is used by researcher to navigate through online map and to select the desired geographical area from online map. Whenever researcher drags the mouse to navigate on the map, the corresponding top-left, bottom-right corner and center points longitude and latitude values are displayed in the respective labels.
Figure 4.110 Second (Optional) step of the implementation of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

(c) When researcher wants to enlarge the geographical area on the map (Optional)

When researcher double clicks the left mouse button on the map, the geographical area can be seen in enlarged form. Thus researcher can focus on the smallest geographical area by double clicking left mouse button as per the requirement

Figure 4.111 Third (Optional) step of the implementation of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.
(d) When researcher wants to shrink the geographical area on the map (Optional)

When researcher double clicks the right mouse button on the map, the geographical area can be seen in shrunk form. Thus researcher can accommodate large geographical area by double clicking left mouse button as per the requirement.

![Figure 4.112 Fourth (Optional) step of the implementation of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.](image)

(e) When researcher clicks on Lock_Map Button.

![Figure 4.113 Fifth step of the implementation of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.](image)
When researcher gets the desired geographical area on the map by navigating or by enlarging or shrinking the geographical area, the next step is to click the Lock Map command button. When researcher clicks such button, the layout defined above in figure 4.113 appears on the screen. This step is mandatory if researcher wants to perform the further clustering operations. With this step researcher fixes the geographical area on the map. Also when researcher clicks on Lock Map command button, the geographical boundaries in terms of latitude and longitude for top-left corner and right-bottom corner are fixed and becomes static. These static longitude and latitude values can be seen on the screen with respective labels. All the components except graphical selector appear on the screen initially. Graphical selector does not appear on the screen until and unless user clicks on map area.

(f) **When Data Populator is clicked**  
This step of the current model is as same as the step performed in the model 4.9.4

(b) **When Data Populator is clicked.** Thus it is not redefined here

(g) **When user clicks on zoom-out component and moves mouse pointer**  
This step of the current model is as same as the step performed in the model 4.9.4

(c) **When user clicks on zoom-out component and moves mouse pointer.** Thus it is not redefined here.

(h) **When user clicks on map area and drag map area. (After Zoom-In)**  
This step of the current model is as same as the step performed in the model 4.9.4

(d) **When user clicks on map area and drag map area. (After Zoom-In)**  
Thus it is not redefined here.

(i) **When user clicks on zoom-In component**  
This step of the current model is as same as the step performed in the model 4.9.4

(e) **When user clicks on zoom-In component.** Thus it is not redefined here.

(j) **When user clicks and drag map area (After Zoom-In).**  
This step of the current model is as same as the step performed in the model 4.9.4

(f) **When user clicks and drag map area (After Zoom-In).** Thus it is not redefined here.
(k) **When user clicks on Lock_Zoom Component.**
This step of the current model is as same as the step performed in the model 4.9.4.

(g) **When user clicks on Lock_Zoom Component.** Thus it is not redefined here.

(l) **When user clicks on plotting area to draw cluster**
This step of the current model is as same as the step performed in the model 4.9.4.

(h) **When user clicks on plotting area to draw cluster.** Thus it is not redefined here.

(m) **When user release the mouse button**
This step of the current model is as same as the step performed in the model 4.9.4.

(i) **When user clicks on plotting area to draw cluster.** Thus it is not redefined here.

4.9.4 **Key Features of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.**

- Unlike the previously defined model 4.8 this model allows researcher to select and capture the desired geographical area from the online map without any boundary or limitation to select geographical area. Also the clustering is performed on the base of longitude and latitude values instead of imaginary x and y coordinates of customer location. Thus model application can be mapped very easily with the real life application.

- This model allows researcher to enlarge or shrink geographical area on the map, that allows to perform clustering operation on very small geographical area as well as very huge geographical area.

- User need not have to worry about how to capture the map of specific geographical area as Model application provides the facility of navigation, enlargement and shrinking to get the desired geographical area and as user clicks on Lock Map the desired geographical area is automatically settled on the application for the further process of clustering.
User need not have to worry about how to fetch the values of longitude and latitude of the top-left and bottom-right corner of the captured /selected geographical of the map as Model application provides the facility of automatic display and updation whenever user navigates, enlarges or shrink the geographical area of the map. Also once user clicks on Lock Map the longitude and latitude values of top-left and bottom-right corners of the captured geographical area are automatically forwarded to the model application for the further process of clustering.

The major feature of this model is that it allows user to create the cluster unlike most of the data mining software that automatically creates the cluster when database is provided and thus model gives the flexibility to the end user to select desired records within the bound of cluster.

End user is getting the flexibility of drawing any shape of cluster as model allows to form the cluster as user moves mouse pointer on the model map area. Thus not restricted with circular, rectangle or any other shape and thus removes the limitation of previous models. User can define a cluster in a way so that 100% of desired records can be bounded or can be selected to be clustered.

Comparatively less prerequisite knowledge required for clustering as almost all the activities of clustering are performed graphically like selection of records, defining shape of cluster and population of selected records in the data grid. Thus clustering model becomes more interactive and easy to understand, ultimately results in increasing decision makers efficiency.

End-user can apply various kinds of other statistical functions on the selected records like total_sales and average_sales as selected records are easily accessible from the data grid.

4.9.5 Limitations of the Clustering Model to extract plotted data from the Online, Navigational & Sizable map in the form of table by taking a Fractal as graphical selector with zoom-in, zoom-out and navigation facility.

It is not necessary that user always want to perform clustering operation, User may want to implement some other data mining techniques like classification, association rule, decision tree etc. But this model only gives the facility of
performing clustering operations. Also clustering operations may not be always required and suitable for user. Thus model application is only useful if clustering is effectively required and implemented.

- Geographical locations in terms of longitude and latitude are perfectly required to be obtained to be stored in the database before applying any clustering operations. Also these information has to be obtained accurately to perform the clustering tasks efficiently and accurately. Thus required to procure the device and services which gives accurate longitude and latitude values of customer location.

- Model application makes the use of Google Map V2 API. In near future Google may stop the support for the Google Map V2. Thus at that time user has to make the changes in the application to feet with the new version of Google Map API.

- If very large geographical area is selected or captured for example any continental or else if very narrow /small area is selected or captured for example any small street then application may not work perfectly.

- If customer’s location are very clumsy in narrow geographical area or very dispersed in huge geographical area then clustering task may not be performed accurately and effectively.

- Tools like Visual Basic 6.0, Ms Access, Activex Controls are used to develop the model application. All these tools may be obsolete in near future, thus researcher has to migrate the model on some other tools.

However Model 4.9 satisfies almost all the requirement define in the beginning phase. Model application fails in some extreme cases only otherwise it performs its task according to the requirement defined in the beginning phase. Graphical selection and fractal shape of cluster provides utmost flexibility and accuracy to perform data mining tasks.
Reference:
    forums.codeguru.com
    stackoverflow.com/questions/.../insert-picturebox-into-picturebox-vb6
    key=ABQIAAAAjU0EJWnWPMv7oQ-jjS7dYxSPW5CJgpdgO_s4yyMovOaV-
    h_KvvhSfpvagV18eOyDWu7VytS6Bi1CWxw