CHAPTER 8
Results, analysis and comparisons
8.1 Introduction
This chapter of this thesis deals with the analysis of results and the comparisons of the developed tools with the other existing techniques. From chapter 3 to chapter 7 we discuss the techniques of the developed tools. These techniques are analyzed and compared with other existing techniques from section 8.2 to section 8.6.

8.2 Digitization
Two digitization techniques are generated which are discussed in the chapter 3. These two techniques are analyzed in the subsequent two sections 8.2.1 and 8.2.2.

8.2.1 Heads-up digitization using mouse click
This technique is described in the chapter 3 (section 3.2). Various digitization techniques are available through which vector maps can be produced from the raster maps. One of such technique has been devised by Mandal, Das and Moitra [153]. In this technique the vectorization is performed by the mouse drag method. There is no temporary storage allocation processes, editing is also not possible and the table space required is also more than the proposed technique.

In TNTmips [154], another well-known and industrially accepted Remote Sensing and GIS software of MicroImages, the mouse click method is used to calculate the coordinates of object constructing points. But no color can be assigned with the objects at the time of digitization process. The blinking facility of selected digitized segment which is available in this proposed scheme is not available in the TNTmips software as well as DOVTG [153] technique. The blinking of the selected object helps the user to understand the object selection at the time of editing. The Comparisons of the proposed scheme with these two techniques are given in the table 8.1.
Table 8.1: Comparison of the proposed digitization scheme with other two existing techniques

<table>
<thead>
<tr>
<th>Features</th>
<th>Proposed Technique</th>
<th>DOVTG [153]</th>
<th>TNTmips [154]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinates calculation</td>
<td>Based on mouse click</td>
<td>Based on mouse drag</td>
<td>Based on mouse click</td>
</tr>
<tr>
<td>Color assignment</td>
<td>Color attributes may be assigned to the objects. For polygons there are boundary and fill color attributes.</td>
<td>Colors are assigned. But no boundary color for the polygons</td>
<td>Colors can not be assigned to the objects</td>
</tr>
<tr>
<td>Buffering</td>
<td>Available</td>
<td>Not available</td>
<td>Available</td>
</tr>
<tr>
<td>Databases</td>
<td>1. Tables does not contain all the boundary point’s coordinates, size of the coordinate labels are not large. 2. Color table exists</td>
<td>1. Since coordinate tables contains all the boundary point’s coordinates the size of the coordinate labels are large. 2. Color table exists but no boundary color for polygons.</td>
<td>1. Tables does not contain all the boundary point’s coordinates so the size of the coordinate tables are not large 2. Color table does not exists</td>
</tr>
<tr>
<td>Edit facility</td>
<td>Integrated</td>
<td>Not available</td>
<td>Available</td>
</tr>
<tr>
<td>Object blinking feature</td>
<td>Integrated</td>
<td>Not available</td>
<td>Not available</td>
</tr>
</tbody>
</table>

8.2.2 Automatic digitization of polygon objects

The technique is described in chapter 3 (section 3.3). This technique is applicable for the raster maps which have uniform segment color and separate boundary colors. If the image has no continuous boundary (closed boundary) for the segment the image has to make suitable for the technique manually. The image correction to obtain continuous boundary may be time consuming. If mouse is clicked inside any closed polygon then this technique automatically calculates the coordinates of the boundary and produce the polygonal vector object. This technique is a new approach of digitization where accuracy is very high, almost 100%.
8.3 Thematic map generation

Using proposed technique polygon based thematic map can be produced. But unlike the most other thematic map generating technique this tool only make a color layer on the actual map. The colored layer exists on the actual map, for this reason it will be easy to identify each sub area. The three operations (boundary digitization, polygon name assignment and attribute value assignment) are to be performed for each polygon one by one. But most of the other technique the data attachment operation performed after the total digitization. That is it is a separate module which has to perform after digitization this separation does not exists here. Also the other techniques produced the thematic map layer as a new object. To analyze the thematic maps in other cases the original map has to open separately just behind the thematic layer. This condition does not arise in this case.

8.4 2D and 3D graphical representation

This decision support system is based on 2D and 3D representation of data on segments of an image. The desired locations of a RS/GIS image/map are selected and data are attached to each location. Selecting the image and attributes, all the attribute data are attached for the selected locations. In this scheme at most eight attributes and five sub attributes under each attribute may be assigned and may be extended on requirements. Depending upon the attached data this decision support system generates graphical representation on the desired locations of the map. Extended view of the pictorial representation is also provided for better visualization of the output schema on the image. 2D bar, 3D bar and cylindrical graph can be generated in this technique for the data analysis purpose. The graphs may be generated on the locations of the image or may be generated separately. The attached data are saved as permanent and any time the decision support system can be run and analyze based on the saved data. The simple files are used as storage of data, so database software is not needed.

8.5 Development of GIS based tools

Two applications have been generated on tea garden which are soil management and pruning management. Some work of designing GIS based tool for tea garden has been done by Das et al., two of them are pest management system and weed control system [152, 188]. But the proposed systems are more efficient and user friendly. The comparisons of our designed techniques for
soil management and pruning management and the techniques developed by Das et al. are described below:

- Das et al. does not digitize the map so map base segment selection is not possible. But in the proposed techniques it is possible. The selected segment also blinks in the proposed technique for better understanding which does not exist in the technique of Das et al.
- Thematic map based attribute representation does not exist in the techniques of Das et al. but this feature exists in this technique.
- Zoom view generation (by drawing mechanism) of the selected segment is not possible in case of Das et al. but it is integrated in our technique.
- Along with the zoom view the visualization of previous and current records of the selected attribute is possible in the proposed techniques but this is absent in the technique of Das et al.

8.6 GIS based change detection

Two applications are generated on change detection. One application is generated to show the changes of the land use classes on the satellite image of Amarabati land (section 7.2) by using the GIS software TNTmips. Logical AND operation is performed on the generated landuse class images of that area. The second one is generated by using java swing language and described in the section 7.3.

The statistical data regarding various changes of a scene is reflected as statistical data/average in figure 7.3.9 and that of graphical representation of the same has been reflected in figure 7.3.12 as the output of the proposed techniques/tools. Overall feature distribution visualization tool reflects various changes as graphical output, shown in figure 7.3.13 and 7.3.14 as a sample snapshot. The outputs designed are menu driven GUI based statistical/visual change reflection generated from multiple scenes of a given latitude/longitude from where different attributes may be selected and changes are viewed. The output scene has been divided into three sub pane/panel out of which statistics regarding various changes are displayed on the right top corner, that of pictorial representation are on the left panel and various menus such as latitude, longitude and attribute selections are given on the right lower pane below the statistics pane (figure 7.3.15). Graphical representation of various changes are depicted/narrated in section 7.3.4 and figure 7.3.16 and
7.3.17 respectively. Percentage wise feature changes as obtained from the implementation are given in table 7.3.1. The salient features generated by the proposed technique are as follows:

1. The input images are easily registered by UL. LR extents by simple geocoding method.
2. The pixel wise comparison is unique in nature as most of GIS product based on theme classes.
3. The changed statistics is displayed simultaneously on the viewer, which is again a unique feature and not available in existing tools.
4. The graphical display of changes is another interesting feature.
5. The query builder is quite unique as it gives an opportunity to make query on the raster regarding changes.
6. The changes are visualized by using suitable graphical symbols and blinking features.

In the work described in section 7.2 the changes were based on remote sensing information model and TNTmips is used as GIS tool. Each class under each satellite images is extracted separately and the changes of each class are shown individually with the help of logical operation between the classes of different sessions. But most of the GIS software has no technique to identify the pixel wise change and graphical representation technique to analyze the feature distributions. So the developed change detection and analysis tool has been developed to facilitate these operations. Most of the change detection techniques [169, 179] are based on classification/segmentation of satellite images. But the proposed tool is based on the RGB values of the pixels under the classes to detect and analyze the changes.

This tool will produce error free result for large scale landuse map where the latitude and longitude are linearly related but the output of this technique fully depends upon the input classification of the image.

The technique generated using java swing is a novel concept and may be implemented for landuse change detection of any landuse class image.