Map making and map updating are the two most important fields today, as the requirement for information retrieval, indexing and identification from the satellite images is playing a major role. Most of the information available about the maps is either very old or has been updated manually periodically.

Active research and analysis of the urban areas is being done by scientists for feature extraction. Though a lot of work can be found in the rural areas for identification of the type of crop, vegetation etc, but very little work is found for the identification of the roads.
Therefore, effective algorithms were suggested for road extraction in rural and urban areas. Complete description of the algorithm, detailed analysis of the results and comparison of the results has been done in different chapters.

7.1 RESULTS AND DISCUSSION

Different algorithms were proposed and discussed in chapters 4, 5 and 6. The review of these experiments is presented here.

In chapter 4, an effective road classification system that extracts roads from the satellite images of rural areas has been discussed. The extraction process performance has been validated by standard quality measures such as completeness, correctness and quality. The algorithm was tried for different layouts of road images and for noisy images by training the neural network for rural and urban images. The algorithm gave 69.08% completeness, 38.208% correctness and 20.75% quality.

In chapter 5, the level set evolution algorithm was described and the robustness was tested by increasing the number of iterations. It is observed that the efficiency of the system increases for the weak boundaries but the time taken for the calculations increases. The performance of the proposed algorithm using is done for several urban/rural satellite images and its robustness to the presence of weak boundaries is observed. The average performance parameters are 76.53% completeness, 16.3% correctness and 7% quality. Completeness of the result extracted improved with this algorithm but the other two parameters were not impressive.

In chapter 6, the proposed novel road extraction technique using gradient process and the formation of skeletal rays over the roads for satellite imagery has been explained. The technique has been implemented and compared with the technique of chapter 4 and this
algorithm achieved a remarkable improvement. The results showed that the automatic extraction algorithm is robust and resilient to heavy noise. It is able to identify partially and sometimes fully obscured intersections correctly based on the nearby road information. The average performance parameters obtained are 73.71% completeness, 30.49% correctness and 20.52% quality.

7.2 CONCLUSION

Today, many suitable and operational satellite sensors exhibiting various spatial, spectral and temporal resolutions are continuously delivering raw imagery. Hence, the time and cost intensive automatic procedures are necessary for converting these images into useful geographic information for the human beings like topographic mapping. The important types of linear topographic objects are roads, rivers, railways and vegetation boundaries. The major linear features of interest right now are roads. Automatic extraction of roads from digital images has been an active research subject for more than a decade. This field is quite young and the major approaches are not settled.

The existing approaches show individually that the use of road models and varying strategies for different types of scenes are promising. However, all the methods are based on relatively simplistic road models, and most of them make only insufficient use of a priori information, thus they are very sensitive to disturbances like presence of vehicles, shadows or occlusions, and do not always provide good quality results.

7.3 LIMITATIONS

Shadows, occlusions, cloud cover presence of vehicles etc., play a very important role in the road network extraction. Owing to the vast amount of satellite imagery data available with
increasing resolution, the processing speed and quality of the algorithms need to be improved. Also there is a continuous change in the infrastructure with the development of different villages, towns, cities, states, countries etc. This information change needs to be updated.

7.4 FUTURE SCOPE

The extraction of the road networks from the satellite imagery can be used in

a. **Digital cartography updating**: with the increasing availability of the remotely sensed imagery the need for reliable and up-to-date maps is growing. The bottleneck in the production of cartographic data lies in the manual processing applied to the data.

b. **Multi-temporal change analysis**: Change analysis from remotely sensed data has been studied for more than thirty years by the Digital Image Processing and Pattern Recognition communities. High resolution imagery raised new difficulties: occlusions, projective distortion, detail profusion or the presence of shadows, create “apparent changes” which do not correspond to real changes of the scene, and therefore make the interpretation difficult.

c. **Content-based image indexation**: The task of automatic image labelling and classification is becoming crucial with the exponential increase of the amount of available images and their variety in terms of acquisition sensor and resolution.