CHAPTER VI

CONCLUSIONS

In chapter V, the development of MR image search database system was discussed. This concluding chapter looks into benefits, contributions and weaknesses of using the proposed object shape based image search database system. The chapter ends with how the development of the proposed system and ASM models search can be further enhanced in future by adding additional features and how the research and development in this area will help to increase and improve the medical success of diagnosing and treating illnesses.

6.1 Summary

The Image storage and retrieval database system can grow and consists of thousands of MR images. Traditional image retrieval systems based on keywords are not applicable to medical image database systems as they ignore the contents of the image [1][7]. Through this study, it was found that objects in the ROI in the MR images modeled using Active Shape Modeling (ASM) toolkit could be linked to the Microsoft Access database. These images are searched using static search or multi-resolution search for modeled object shape in the ROI.

It was noted that the ASM search algorithm is quite limited to various parameters such as the size, pose and shape orientation of the objects in the ROI selected. In order to have a good search model, at least 10 MR images are needed. Since there were only five brain images, the model created was not enough to be used as search model as it lacked variation. This was seen when dynamic view was used to view the brain image model animation.

Accurate modeling is necessary in order to have a reliable image model to search for matching images of previous patients that can be used in diagnosis of future patients. It was also found that the Access database does not support direct storage of images. The image database system can be improved by creating an interface that links both ASM toolkit and Microsoft Access database. This will make the search and retrieval process less complicated for the users of this system. An attempt was made to link the sample database with ASM search. However, the interface created was not fully functional as ASM toolkit program is not stable and needs to be debugged for errors.

At the moment, the proposed object shape based image database system can be linked to images and object models that are stored in flat files. ASM toolkit is used to load images and to search for a match with the object model produced. This is inconvenient but it may be sufficient to

get started. This method is still better than searching for patient records and images manually.

6.2 Benefits of Shape-Based Image Retrieval

The shape of the heart on the MR images is modeled and stored in a database. Once the database is created, information about patients and images are mapped on a form as shown in the Appendix C. This allows a better display of retrieved data. The database can be queried for matching images, patient information, diagnosis and treatments given.

Reports can be generated to show analysis related to patients' information, images used in diagnosis process and the treatments given. The database can be backed up regularly for safe storage and retrieval of information. The image sequences can be used to generate 3D models, which can be stored as Object Linking and Embedding (OLE) object. This database has the potential of becoming a knowledge base with which doctors can make important treatment and surgical plans.

6.3 Weaknesses

This system requires a huge investment on hardware, software and human resources initially to scan, segment and store the MR images of all past and present patients.

ASM static search and multi-resolution search is used to search for matching MR images with a given patient's MR image using ASM toolkit as front end and database as back end. This technique requires in depth knowledge of Matlab coding. In addition, the ASM toolkit is not a stable software and therefore modeling images using this software and integrating the information in an interface is quite a challenge.

Linking the database to the images stored in flat files poses limitations on efficient retrieval of matching images. Microsoft Access database may cause problems on updating and inserting data as it has limitations on the number of maximum concurrent users to the system, which may not be practical for large hospitals. The concurrency problem was not tested in this study, as Matlab could not be linked with the sample database created using Microsoft Access. User training and acceptance to the proposed object shape based image search database system must be done so that the users are comfortable to use it for accurate diagnosis and treatment.

6.4 Contributions

The proposed usage of object shape based image search database system can act as a prototype. It can be used to assess the needs of the

medical personnel in a hospital to efficiently store and retrieve modeled MR images for faster diagnosis purposes.

Through this study, it is clear that a simple database program like Microsoft Access can be deployed to link images with patient information. Even if the ASM concept is not incorporated with the database system, it is useful to have a database in large medical records environment for storing patient records as it allows queries, reports and forms to retrieve and display information in a more efficient and orderly manner.

6.5 Future enhancements and suggestions

Object relational database systems should be considered instead of relational models, as the database gets more complex with lots of data and images. The object-oriented systems are good at expressing complex relationships among data objects and are good at data manipulation. This database system is based on the tight integration of code and data, flexible data types, hierarchical relationships among data types, and references [33].

Perhaps in the near future, an enhanced modeling software application should be researched and developed that can run on top of the database platform to automatically model the object in the MR images stored. This application should include features like easy database connection, three

dimensional (3D) modeling and VRML capability to look at the affected region of interest (ROI) clearly. Appendix G shows a sample 3D model of heart in VRML enabled browser. However, these features can add heavy load to the database and can affect the query processing speed. A study on how compressing and decompressing data can improve the image retrieval must be done in order to save data storage space and time taken to process query results.

6.6 Concluding remarks

Investigation on using the ASM toolkit to model and store MR images in a database was done in this study. The search process using static and multi-resolution search helped in finding the heart object model in the region of interest (ROI) in a very short span of time. The Microsoft Access database program chosen does not support image files storage directly into the database. Linking the images to the flat files solved this problem. This problem can be avoided if better database programs like Oracle or SQL server are used.

The lack of a variety of MR images poses a limitation on this study. Conducting future research in real hospital environment with actual and large number of image sets are necessary to quantify the efficient retrieval of matching images from the object shape based image search database system.

Research and development of better modeling software is suggested to include stable connection with a database, 3D modeling and VRML capability. Automatic modeling is suggested to save time spent on modeling the images in large hospital environment.

For now, the ASM toolkit can still be used for modeling but have to be debugged for errors to ensure its stability and reliability for accurate modeling. It also has to be integrated with a database in a user-friendly interface for ease of use by users. In addition, compressing and decompressing the images stored for retrieval purposes must be studied to have a compromise between time and space consumed by the object shape based image search database system.