Mammographic Risk Assessment: An investigation into expert observers, grey-level and texture representation

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November
2007

This thesis is submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy of The University of Wales.

Declaration

This thesis has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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This thesis is the result of my own investigations, except where otherwise stated.

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ABSTRACT

This thesis investigates computer-based mammographic risk assessment. It covers investigation on how radiologist classify the mammographic risk, what features which determine mammographic risks, and how these features transformed into computer vision problems so as it can be implemented for designing an effective Computer Aided Diagnosis system.

It is known that mammographic density is an important indicator for breast cancer development. Yet, it has not been included in the predictive risk models due to subjectively high variability on its estimation. Based on this, automatic (computer-based) mammographic density estimation and/or classification had become the main research focus within this thesis.

In assessing mammographic risk, radiologists use both quantitative and qualitative approaches. Quantitative approach is based on proportion of mammographic dense areas which can be translated into image processing term as density (image intensity) segmentation problem. On the other hand, qualitative approach uses mammographic parenchymal patterns which reflect morphological shapes of breast tissues. The latter approach corresponds to texture information in computer-vision problem. Hence, we investigated contributions of intensity, texture, and combination of both in describing the mammographic density.

Two novel methodologies have been developed, namely: texton-based segmentation with respect to Tabár breast tissue models and multi-histogram based for mammographic density classification. The results obtained are promising, the limitation of proposed methodologies are discussed.

The texton-based segmentation results can be used for mammographic risk assessments, especially according to Tábar's Mammographic Patterns model. By taking the nodular and homogeneous blocks only, the texton-based segmentation results could also be used for mammographic density assessment using Boyd's percent density metric. This approach potentially could be used by radiologists to estimate mammographic density automatically.

The multi-histogram based approach shows good performance for automatic mammographic density classification in comparison with published work. This approach may have the potential for implementation for mammographic screening data. However, the possibility to use this approach for density segmentation needs to be investigated further.

ACKNOWLEDGEMENTS

I am so grateful for the chance to do the research in medical imaging which has open many doors and opportunities. By taking me as his student, I thought Dr. Reyer Zwiggelaar has taken a high risk to challenge a bad odd. Since day one, I made a promise to myself to honour his trust.

The studentships from Universitas Islam Indonesia (2003-2005, 2006-2007) and Islamic Development Bank (2005-2006) are gratefully acknowledged.

I would like to thank Dr. Erika Denton from Norfolk and Norwich University Hospital for her generous supports and time to provide the "truth" mammographic ratings and loads of mammographic textures. Also, I would like to thank many people whom have helped me in understanding the mammography system, to name a few: Glynis Wivell (NNUH), Yvonne Pointer (Breast Screening Unit, Norwich), Gillian Baxter (Breast Screening Unit, Northampton), Dr. Ralph Highnam (Mirada Solutions), and Yutaka Taniguchi (Fuji Photo Film Europe).

Thanks also to Dr. Yonghuai Liu for his wise advices on my messy draft. Many thank to all members of Vision, Graphic, and Visualisation Groups whose helpful comments and the knowledge sharing improved my works. It is so nice to be a member of C57 buddies (Mike, Alan, Martin, Dave, Colin, Clarey, Janet, Will, Da, Joe, Najm, Maram, Li, Xu, Charlie, Costas, Ed, and Wenda) whose offer a wonderful mix of productive office hours and very pleasant socials. Thanks so much, guys and girls.

Sometime, I really think that my middle name is Trouble. I am appreciated everyone whom patiently endures the troubles which I caused: Pete, Sandy, Dave (cs-support), Margaret, and Ruth. Thank you very much.

There were days when you were even unable to make your own cup of tea. But luckily, your friends are just being there for you. I am so lucky to have them: Hajer, Nida, Ifat, Niouma, Amy, Dawn, Fatma, Karin, Liz, John of Shilam, and Djou of Casablanca.

Special thanks to my parents, parents in law, sisters and brothers who have been so supportive and sacrifice many things to enable me to achieve my dreams. Last but definitely not the least; I would like to thank Mas Diding for his permission, patience, big hearts, and love. I still remember the day when we traveled 20 hours by many transport means to Jakarta for the PhD interview. This PhD journey would be unbearable without him accompanied. I would like to express my gratitude to him in our *native Java* language: "Matur nuwun sanget, Mas".