

# A Framework-Based Virtual Colonoscopy System

Ku-Yaw Chang, Shang-Chih Lin, Shao-Jer Chen

E-mail: canseco@mail.dyu.edu.tw

## ABSTRACT

Virtual colonoscopy is a computer-based alternative to traditional optical colonoscopy for examining the interior structures of human colon. This technique is often used to examine colonic polyps for early colon cancer detection. What physicians see could be remains inside the colon, not the colon itself. Even seeing the colon surface is not enough. In clinical examinations, physicians are forced to go back and forth between 2D and 3D images, which become a very time-consuming procedure. Since virtual colonoscopy integrates medical imaging and computer graphics technologies, it requires much effort to develop such a system. It, therefore, becomes quite an important issue of how to easily build a virtual colonoscopy system as a platform for further research. In this paper, we describe a practical approach of building a virtual colonoscopy based on the framework composition technology, including using MFC(Microsoft Foundation Class) for graphical user interface, ITK (Insight Toolkit) for image segmentation and VTK(Visualization Toolkit) for scientific visualization. Building applications based on frameworks allows developers to reuse common functionality and then focus on solving domain-specific problems.

Keywords: Virtual Colonoscopy、Surface Rendering、Application Framework、Image Segmentation

## Table of Contents

封面內頁簽名頁授權書 .....	iii	中文摘要 .....	iv	ABSTRACT .....	v	誌謝 .....	
.....	vi	圖目錄 .....	ix	表目錄 .....	xi	第 1 章緒論 .....	
.....	1	1.1 研究動機 .....	2	1.2 研究目的 .....	2	1.3 論文架構 .....	3
第 2 章相關研究 .....	4	2.1 框架 .....	4	2.1.1 MFC .....	4	2.1.2 ITK .....	
.....	5	2.1.3 VTK .....	6	2.2 虛擬大腸鏡 .....	7	2.3 大腸分割相關作法 .....	
.....	10	2.3.1 自動分割 .....	10	2.3.2 半自動分割 .....	11	2.4 液體移除相關作法 .....	
第 3 章系統流程 .....	13	3.1 檔案讀取 .....	18	3.2 影像分割 .....	18	3.2.1 液體的移 .....	
除 .....	19	3.2.2 大腸的分割 .....	26	3.3 表面呈像 .....	28	3.4 遊走 .....	29
3.5 循序圖 .....	29	第 4 章結果與討論 .....	33	4.1 液體移除實驗 .....	33	4.2 大腸重建結 .....	
果 .....	37	4.3 討論 .....	40	第 5 章結論與未來展望 .....	41	參考文獻 .....	
.....	42						

## REFERENCES

- [1] Sato, M., Lakare, S., Wan, M., Kaufman, A.E., Liang, Z., and Wax, M.R. " An Automatic Colon Segmentation for 3D Virtual Colonoscopy, " IEICE Transactions on Information and Systems, E84-D(1), pp.201-208, 2001.
- [2] 黃千芳、賴世偉和劉秋松, " 大腸癌的篩檢 ", 基層醫學, 第二十一, 第七期, 頁 193-196, 民國 94 年。
- [3] Ko, C.C., and Jang, J.W. " Interactive Polyp Biopsy based on Automatic Segmentation of Virtual Colonoscopy, " Proceedings of the Fourth IEEE Symposium on Bioinformatics and Bioengineering, pp.159-166, 2004.
- [4] Chen, D., Wax, M.R., Li, L., Liang, Z., Li, B., and Kaufman, A.E. " A Novel Approach to Extract Colon Lumen from CT Images for Virtual Colonoscopy, " IEEE Transactions on Medical Imaging, Vol.19, No.12, 1220-1226, 2000.
- [5] Hong, L., Kaufman, A., Wei, Y.C., Viswambharan, A. Wax, M., and Liang, Z. " 3D Virtual Colonoscopy, " Proceedings of the 1995 Biomedical Visualization, pp.26-32, 1995.
- [6] Lorensen, W.E., and Cline, H.E. " Marching cubes: A High Resolution 3D Surface Construction Algorithm, " Computer Graphics, Vol.21, No.4, 163-169, 1987.
- [7] Kitware Inc. " An Object – Oriented Approach To 3D Graphics, " United States of America, Kitware Inc., 2003.
- [8] Lee, T.Y., Lin, P.H., Lin, C.H., Sunm Y.N., and Lin, X.Z. " Interactive 3-D Virtual Colonoscopy System, " IEEE Trans on Information Technology in Biomedicine, Vol.3, No.2, pp.139-150, 1999.
- [9] Fayad, M.E., Schmidt, D.C., and Johnson, R.E. " Building Application Frameworks: Object-Oriented Foundations of Framework Design, " New York: John Wiley and Sons, 1999.

[10] Proise, J. " Programming Windows with MFC " 2nd ed. Washington, U.S.A., Microsoft Press, 1999.

[11] Ibanez, L., et al. " The ITK Software Guide, " U.S.A., Kitware Inc., 2005. [12] Kitware Inc. " The VTK User ' s Guide, " United States of America, Kitware Inc., 2003. [13] Sun, X., Qian, T., Li, M., and Gu, L. " Interactive Virtual Colonoscopy System based on CT Volume Images, " IEEE International Conference on Communications, Circuits and Systems, Vol.2, pp.912-915, 2005.

[14]