

Three-dimensional graphics system of medical images on the Web for patients

Koji Kobayashi^{*1}, Koichi Ito^{*2}, Takafumi Aoki ^{*2}

^{*1} Vocsis Corporation

^{*2} Graduate School of Information Sciences, Tohoku University

Disclosure of Conflict of Interest

Author Koji Kobayashi is an employee of Vocsis Corporation, Kanagawa Japan

This joint study of Vocsis Corporation and Tohoku University does not include any monetary relation between the parties

Introduction

- CT and MRI provide excellent imaging of the human body which is precise, high-resolution, three-dimensional, and non-invasive
 - The invaluable sensors can contribute to many aspects of human health
- The scan data is rarely used to its fullest potential
 - Physicians usually only inspect the parts of the images that are related to the organ of interest
- Reasons of this are;
 1. The tomographic images are meaningless to non experts
 2. The image processing function of the scanned data is provided by workstations at hospital
 3. Diagnosis by computer is not popular



Example of CT image

The Big Data not Noticed

- Japan has the largest number of CTs and MRIs per population in the world
- 46 million scans are made in a year
 - 127,000 scans per a day
 - One in three people has a scan once a year

In order to develop the AI technology, the Big Data accompanied by human's interpretation of small outliers is most essential, and Japan has advantages in both conditions

Number of scanners

	CT			MRI		
	Country	Density	Scanners	Country	Density	Scanners
1	Japan	101	12,943	Japan	47	5,990
2	Australia	51	1,148	United States	34	10,815
3	United States	41	12,740	Italy	25	1,463

Density is the number of scanners per million population, Global Note Statistics, 2014

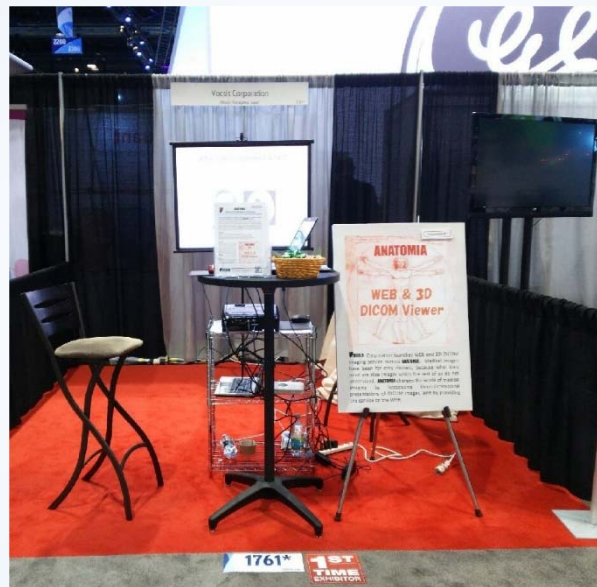
Number of scans

		Facilities	Scanners	Scans/M	Est. Scans/Y
CT	Hospital	6,417	7,716	2,331,652	27,979,824
	Clinic	5,360	5,400	275,065	3,300,780
MRI	Hospital	3,994	4,531	956,692	11,480,304
	Clinic	1,919	1,977	297,329	3,567,948
Total		17,690	19,624	3,860,738	46,328,856

Operating condition of medical image scanners, Medical facility survey, Ministry of Health, Labor and Welfare, 2014

Purpose

- To extract potential values from CT or MRI data, we developed **three-dimensional model** generating algorithm that performs well on internal organs
- To provide patients opportunities to observe the condition of their internal organs, we developed and established a **WEB based** medical image processing system



Exhibition booth of Vocsis Corporation at RSNA 2015

A prototype representing this concept was exhibited and highly appreciated by experts at an RSNA exhibition

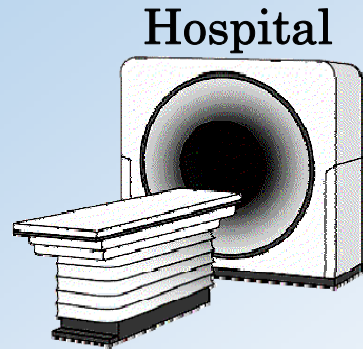
Method

- Patients acquire their scan data from hospital copied on a medium such as a CD-ROM
 - Patient has a legal right to request the copy as the disclosure of the personal information

The scan data can be obtained at minimum time and cost, if the hospital recognizes the patient's intention to use

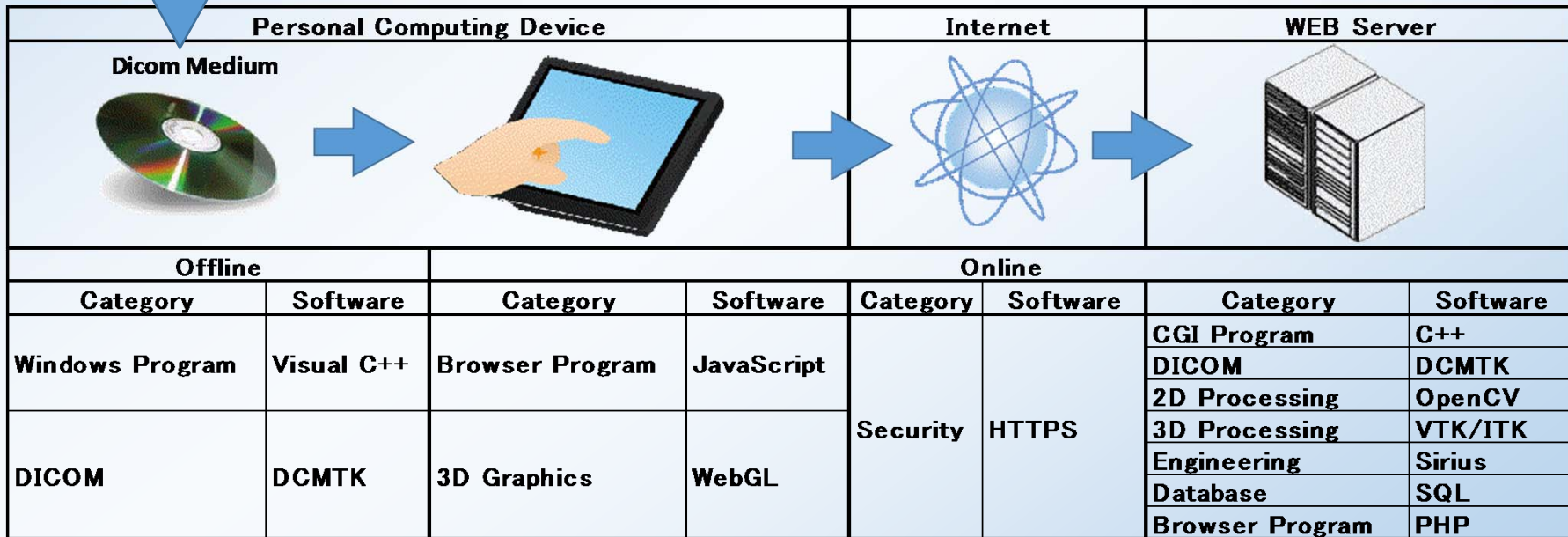
- Patient creates medical image files to upload by using an offline analysis tool
- **Web based** medical image processing system is constructed
 - By applying internet browser as human interface, it is highly available to patients
- **Three-dimensional** models of the internal organs are generated by the WEB server
 - Anyone can recognize the condition of the internal organ intuitively by watching the three-dimensional model of the organ

System Overview



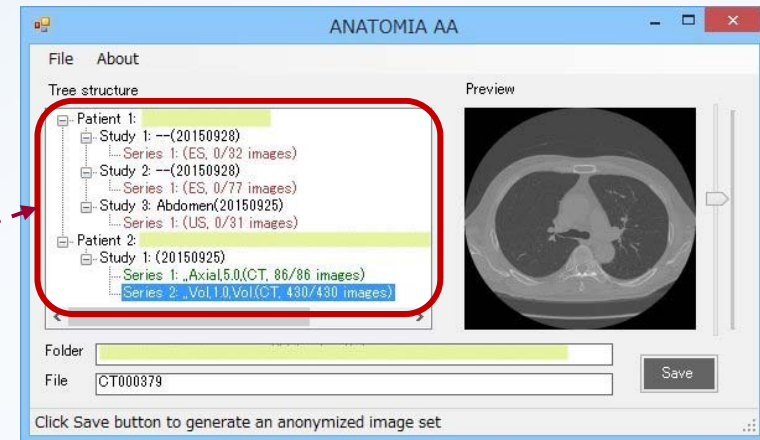
- Various latest software technologies are applied to build the medical image viewer function

Software architecture of the system

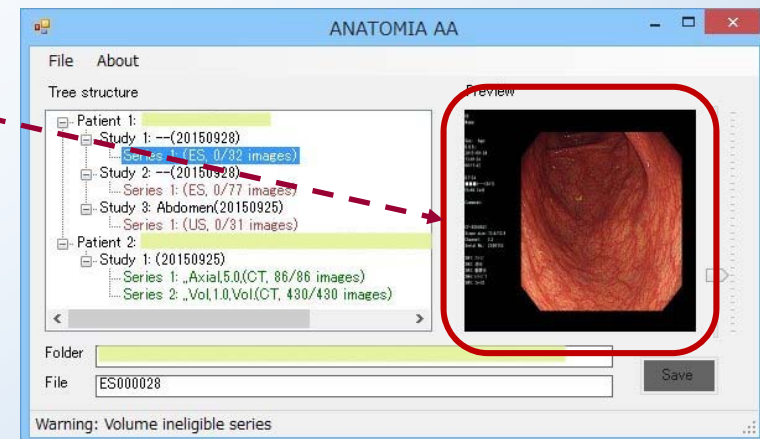


DICOM Medium Analysis Tool

- Help patients to locate individual sets of scan data on the media
 - An application program runs on Windows OS
- Analyze the DICOMDIR file, and generate **a tree structure** of all the medical image files on the medium
 - **Image display** capability
- Create a folder for uploaded files
- Make the files anonymous by eliminating personal information
 - Protect the personal information against potential risk from internet transmission



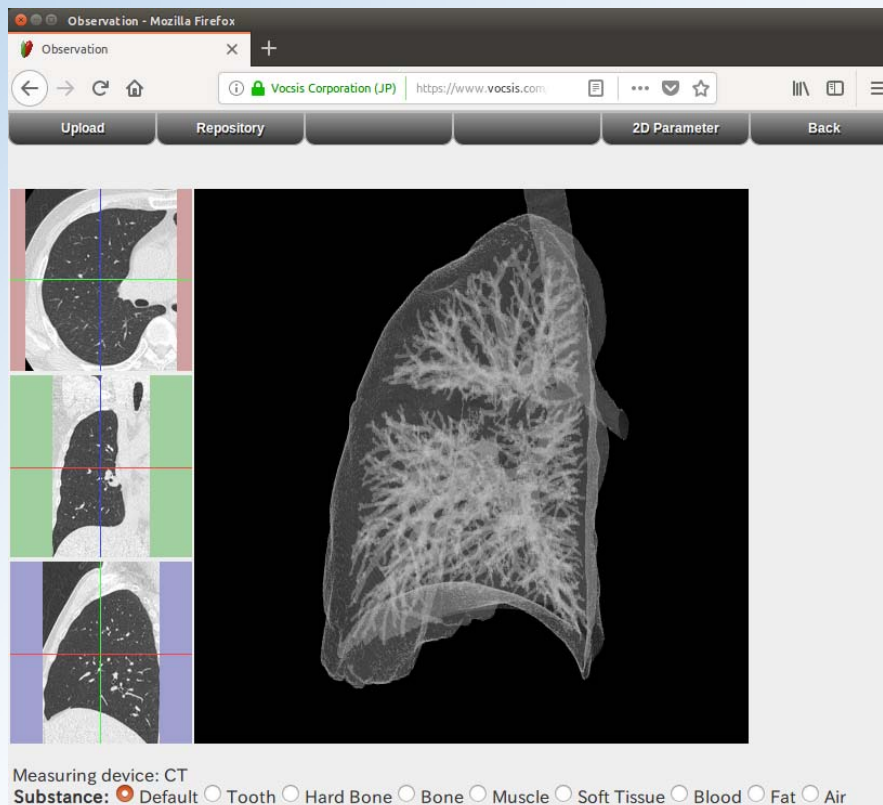
Example of CT Image



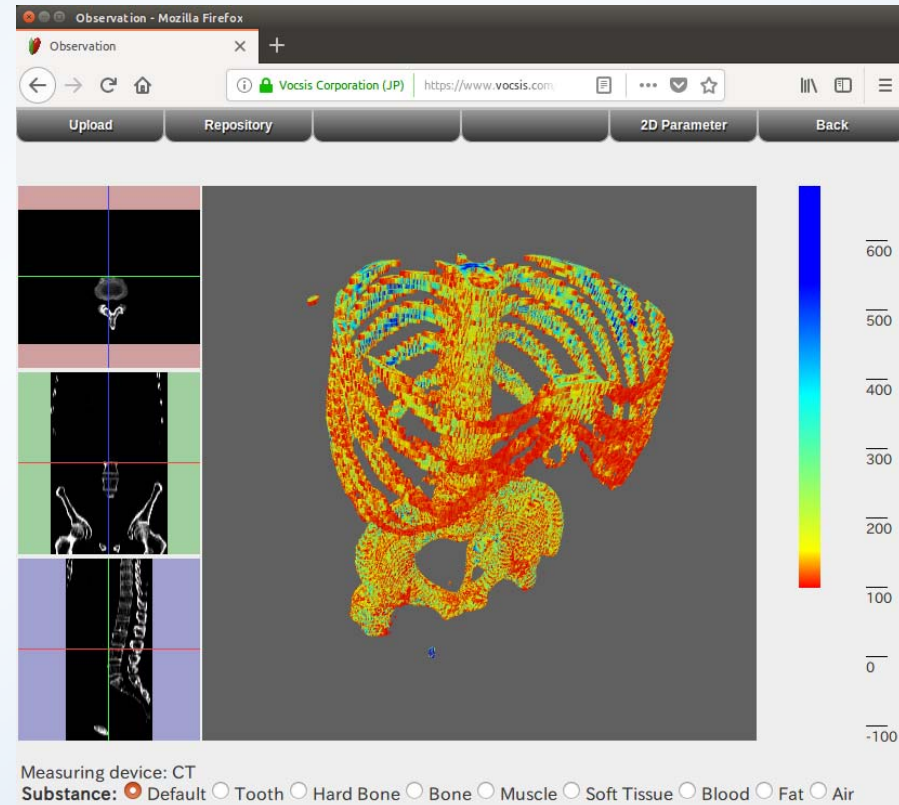
Example of Ultra-sound Image

Three-dimensional Model Generation

- Three-dimensional models significantly improve the intuitive perception ability of people in the state of the internal organs



Example of surface rendering
Structure of bronchiole is shown with conventional cross-sectional images on the orthogonal axes on the left



Example of volume rendering
Cartilages are shown red while bones are yellow or blue

Repository - Mozilla Firefox

Repository x +

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Load Data Delete Data Add Repository Back

You use 5 files out of 20 available file spaces

Root

- 1. CT: 2018-02-18_15:08 512x512x101 abdomen
 - (1) 2018-02-18_15:49 bones
 - (2) 2018-02-28_21:01 vr bones
- 2. CT: 2018-02-18_15:56 512x512x430 lung
 - (1) 2018-02-19_12:58 right lung

Results and Discussion

Results:

- A complete scheme of medical image viewer for patients is implemented on the Web technology
- The viewer provides stress-free response by optimal functional distribution among the components in the system
- The internal organs with clear boundaries on the slice images are well extracted as three-dimensional models
 - Examples: CT bones (calcium), lung (air), MRI vein (blood)

Discussion:

- Patients need three-dimensional models of all the internal organs on the scan data
 - By obtaining a sufficient number of samples to cover the variations, automatic segmentation capability of the internal organs with ambiguous boundaries should be developed

Conclusion and Future Work

Conclusion:

- The medical image viewer on the Web with three-dimensional model generation capability provides patients with the ability to scrutinize the structure of their body for their health

Future Work:

- We would like to cooperate with hospitals that provide numbers of data for us to develop the automatic segmentation function of the internal organs of ambiguous boundaries
- A deep learning based computer-aided diagnostic technology should be developed by applying the automatic segmentation function and the Big Data of the medical scan images

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to experience this innovative
technology**

Next to the CyPos Viewing Area, Marine Lobby (1st Floor)