Educational Practice of Computer Science in Medical Imaging

ZHANG Xue-jun
Medical Imaging Department
Tianjin Medical University
Tianjin, China
ydzhangxj@126.com

ZHANG Yun-ting
Medical Imaging Department
Tianjin Medical University
Tianjin, China

GUO Li
Medical Imaging Department
Tianjin Medical University
Tianjin, China

GUO Hong
Medical Imaging Department
Tianjin Medical University
Tianjin, China

LI Ying
Medical Imaging Department
Tianjin Medical University
Tianjin, China

***Abstract*—Medical imaging is a science using a variety of medical imaging techniques to diagnose and treat human diseases. In these years, the digitalizing progress of medical imaging, from collection and display to reconstruction, diagnosis, transmission, storage and so on, is closely bounded up to the maturity of computer software technique with no exception. Therefore, the development of medical imaging brought forward higher request for computer curriculum. To meet the request which the development of medical imaging subject brings to computer curriculum, the computer science curriculum for medical imaging major should include: computer basic; C language; VB language; imaging processing; radiology informatics and so on. This paper puts forward the following teaching methods: educational method that closely combine theoretic and practical, beginning with programming theory and establishing thinking pattern of programming design, reforming traditional medical teaching concept and solving educational problem of the combination of science, engineering and medical courses.**

Keywords- Medical Imaging; Computer Science; Educational Practice

I. INTRODUCTION

Medical imaging is a science using a variety of medical imaging techniques to diagnose and treat human diseases. The development of Medical Imaging began after Roentgen discovered X-ray in 1895 and X-ray applied on human imaging in 1896, then radiology, a medical subject which is used for human detection, took shape. Since 1896, radiology has developed from singular X-ray imaging technique to medical imaging which embraces multiple imaging techniques step by step. Specifically in recent a couple of years, with the racing development of computer technology, the development of imaging techniques which is closely related to computer science, flourishes with each passing day, and medical imaging has turned into one of the fastest growing subject in medical area. For these years, the digitalizing progress of medical imaging, from collection and display to reconstruction, diagnosis, transmission, storage and so on, with no exception is closely bounded up to the maturity of computer software technique. Great effort has been put in the arithmetic research, model construction, software constitution, data construction and database and so on that are related to medical imaging, makes rapid progresses in medical imaging area, also gets extensive application in clinic field.

II. MEDICAL IMAGING SUBJECT AND CONDITION OF EDUCATIONAL PRACTICE

A. Connotation of modern medical imaging

Medical imaging is a up and coming branch of subject which has gradually taken shape and grown on the basis of traditional radiology after CT came out in early 1970s. Modern medical imaging contains all examination patterns in medical field whose purposes are showing morphology information of human organs and tissues in general, including traditional radiology, ultrasound, CT, DSA, MRI, nuclear imaging(gamma camera, SPECT, PET), DR, CR and so on. Furthermore, the rising and maturation of interventional radiology that aims in treatment has greatly enriched medical imaging field, which makes medical imaging has functions of both diagnosis and treatment[1].

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B. *Trend of Development in Medical Imaging*

a) Trend One: modern medical imaging is shifting from macroscopic to microscopic, that is from the stage of reflecting morphology as imaging basis to reflecting physiological, functional, metabolical and molecular/genetic imaging, also shows the trend of combining morphological imaging and functional imaging. The appearance of this trend is relying on the renew of all imaging means, within 30 years of CT application, SCT, MSC, EBCT and dimension CF showed up on after another; trend of MRI development is gravitating towards high field intensity, real time imaging, fMRI, micro-structure imaging, MRS on molecular level and inhibiting technique in homogeneity and congeniality; ultrasound is growing to ultrasound radiography, three dimensional ultrasound imaging, and high intensity focus ultrasound; the direction of nuclear medicine development is also molecular nuclear medicine. As a result, the development of medical imaging in future will not just in morphology imaging, but in functional imaging more.

b) Trend Two: digitalization makes the network of transmission and storage of medical imaging pictures realized, image analysis is shifting from qualitatively to quantitatively, which makes diagnosis pattern develop from film-picking and reading to digital-picking and teleportation. During the progress of medical imaging development, the imitating image of tradition X-ray photograph advanced to digital image, CR, DR replaced traditional X-ray photograph. Meanwhile, CT, DSA, MRI, SPECT, PET, Ultrasound have been digitalized as well, this prompted the formation of PACS, and made different imaging information meet teleradiography that can remote-control transmit by network, with the push of information science, PACS / RIS has matured and widely spreaded, in addition to HIS integrated, network-imaging and CAD will come into real. Medical imaging equipment is totally heading to digitalization, makes medical imaging into a brand new digital era, leads clinical medicine into digital era. Informatization of images has already become the newest stage of medical imaging development, makes connection of this subject expand.

c) Trend Three: the diversification of medical imaging techniques, blending and intersecting of knowledge of medical imaging includes medicine, mathematics, physics, informatics, has become one of the critical features of modern medical imaging, and the developing trend of future medical imaging. For instance, the exploitation and utilization of CT, MRI imaging software, makes its speed and resolution elevate dramatically, perfusion, dispersion, emulation techniques arised too, application and development of mathematics, physics, informatics in medical imaging field in future will certainly become the important motivation for the enlargement of modern medical imaging.

III. REQUIRMENT OF DEVELOPMENT OF DEVELOPMENT OF MEDICAL IMAGING TO PROFESSIONAL HIGHER EDUCATIONE

Medical equipment is improving and bettering, examination technique and method are also innovating, medical imaging diagnosis has already shifted from diagnosis singly based on morphology changes to a brand new general diagnosis system that includes morphological, functional and metabolical changes. These will change the pattern of practice and service in medical imaging, give medical imaging a more important status in future medical service system. With gradually developing of medical imaging, modern medical imaging has become a subject that multiple subject like physics, mathematics, computer science, biochemical engineering, informatics, medical imaging techniques and clinical medicine intersected[2]. Therefore, new requests must be brought up to professionals in this specialty and professional education. Within modern medical imaging educational system, necessary knowledge of advanced mathematics, physics, computer science must be included, and computer science should be a curriculum whose ultimately goal is image processing. In pace with the gradually bettering of processing and analyzing digital images theoretically and technically, and the rapid development of digital medical imaging techniques, processing and analyzing digital medical images has gradually became the hot spot in domestic and external studies. Medical imaging[3] is a intersected field of medical imaging, mathematical modeling, processing and analysis of digital images, artificial intelligence, numerical algorithms and so on, consisting of segmentation and analysis of ROI; image registration and Intelligence Fusion; function analysis of time sequence images; medical imaging retrieval system that based on content; establishment of medical images databases and evaluation standard; mature research results form commercial software. The appearance of these new techniques, the old solely computer basic knowledge can no longer meet the needs of professional progress. Therefore, the development of medical imaging brought higher request for computer curriculum.

IV. CONSISTENCE OF COMPUTER SCIENCE CURRICULUM FOR MEDICAL IMAGING MAJOR

Aim to the request which the development of medical imaging subject brings to computer curriculum, the computer science curriculum for medical imaging major includes: computer basic; C language; VB language; imaging processing; radiology informatics and so on.

Computer basic is a subject that uses basal knowledge of computer software and hardware which bases in grade one test, Windows system operation, Office operation as major content. The teaching purpose is to cultivate mastering general abilities of computer basal knowledge. Besides, computer application, hardware and aegis, operating system basic, internet basic, procedural language primary, database primary, multimedia primary, message retrieval are also parts of this course, these contents focus on cultivating the student to master the basal information of all kinds of computer techniques and the ability to use computer to solve actual problems[4].

The C programming language: by learning this course, the students can master the basal grammars, sentences, control structure and the method of top-down structured programming, helps them realize the importance of algorithm, good program, designing style and practice in studying progress of this course, cultivates the ability of the students to use programming

language to analyze and solve real problems. What is more important, programming language is also a part of university quality education and computer basic education[5].

VB programming language: for establishing the combining course of programming design and medical image processing, we choose VB programming language, makes the students fully grasp the programming technique of achieve medical image processing algorithm based on VB programming language, fully understand the steps and running procedures of image processing algorithm, this makes the radiology major students have adequate medical theories, they can not only edit medical images under certain programming circumstance, achieve medical image processing operation, but also can give pretreatment(image smoothing, sharpening, contrast variation), edge detection, cut up interest area editing to medical images and so on.

The reason of choosing VB as programming environment is that it is richly endowed by nature. VB is one of the most popular programming languages currently, it has characteristics like easy to learn, user-friendly interfaces, powerful application, low expense, quick effect, these can provide convenience to writing systemic and applied software, especially for medical major student carrying out researches. Students major in radiology has certain programming basis, familiarity programming theory by relevant computer basic course training prophase, this is what the students in other majors lack of, and this fixes the foundation of knowing the principles and norms of some image processing tool of medical equipments for radiology major students.

Based on the medical image processing of mat lab, MATLAB has become one of the best worldwide accepted scientific and technological application software, which is programming easily, powerful data visualization function, good operability and so on, in addition it equipped with image processing tool box with powerful, flourished professional functions, it is a requisite software for image processing work. The course can link MATLAB and medical image processing, can expound medical image processing method using MATLAB totally and systemically, provides knowledge storage for radiology major student for science research.

Medical imaging informatics: refers to a medical imaging chain, contains "formation of medical images, picture obtain, picture communication, picture management, picture storage, picture process, picture analysis, picture display(visualizing) and picture explain", this "picture formation" means improvement and expansion of imaging modes. Getting traditional medical imaging, medical image processing and PACS together orderly. However, it's not simply knock together, it make the image chain optimization in this process, providing more educational, more accurate, more convenient, faster transmit, and get more added value from radiology data at the same time[6].

V. EDUCATIONAL METHOD

A. Educational method that closely combine theoretic and practical

Because the ultimate goal of computer programming courses is to cultivate actual programming ability of students, theoretic study is the indispensable basis, therefore we use "close reading" method in theoretic teaching, stress the core conception and knowledge of the content of every theoretic period, don't put much effort to other content, but leave the thinking to students themselves. By using lots of typical cases to explain the profound in simple terms, and add some examples related to medical imaging, encourage the students who are able to study more to learn by themselves. After getting a fully recognization of programming design, the students can grasp the focal points to construct programming design frame. Meanwhile, emphasis" practice more" to students, giving certain amount exercise in connection with the core content of every course, let the students practice as much as possible, encourage the students to try to solve examples in different programming ways, make practice insert in the theoretic courses, bring practice into assessing the score of final examination, which can provoke the enthusiasm in learning of students, cultivate programming theory and practice ability systemically.

B. Begin with programming theory, establish thinking pattern of programming design

Computer curriculum is based on mathematic and physical knowledge, is a very practical science subject. Educational pattern in which theoretic learning and practice is disjointed apparently doesn't suit for computer science, especially for the teaching of programming design course. The students seems to have clearly understand of what the teacher said, but don't know which to begin with once they write practical program. That's because the students don't establish the thinking pattern of programming design, it's difficult to set connections between feature of drive of the event and control programming. Therefore, computer curriculum needs not only theoretic teaching, but also plenty practical periods to emphasis actual programming and application abilities.

C. Reform traditional medical teaching concept, solve educational problem of the combination of science, engineering and medical courses

Because in medical teaching, more emphasis is put in visual thinking which is different from mathematics and physics. Therefore, combined the goal of talented people cultivation, for medical imaging major students, we adopt the way that constantly teaching science and engineering courses in 5 years, from the first year in college, directly joint high school curriculum, implant thinking pattern and concept of science and engineering subjects to medical students, guide the students to adapt learning methods and habits of science and engineering subjects, this is one of the way to solve the "how does medical students involve in science and engineering knowledge" problem.

VI. SUMMARY

Modern medical imaging, as the result of the highly combination of life sciences and information sciences, its development will influence the development of the whole clinical medicine. The condition of how the students master

computer related knowledge, will directly influence medical imaging knowledge system and control of clinical and scientific skills after graduation.

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