Construction of dataset for Virtual Chinese Male No.1

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Abstract: Objective ToestablishdigitizedVirtualChineseHumanMaleNo.1(VCH-M1)imagedatasetwitha0.2-mmequal interval. **Methods** Thebodyofa24-year-oldmalewasusedforthisstudy.Perfusionwithphenolandvermilionofthearteries was performed, followedbybodyshapeadjustmentbycoldsalineandpre-embeddingwithbrokenicesinanupside-down position, whichwascompletedinastepwiseproceduretominimizebodyshapedeformation. Sectionmillingwasconducted subsequently with the section thickness of 2 mmandthesectionimageswerecaptured by digitalcamera, which were immediatelytransferredtoa computer forstorageand processing. **Results** A totalof9232sectionswereobtainedforthe whole body, and the resolution of each of the image in TIF format was 3 024伊 016 pixels, resulting in the size of approximately18Mforeachimageandabout161Gforthewholedataset. **Conclusions** ComparedwithVCH-F1,theimage qualityinVCH-M1datasetissignificantlyimproved,demonstratedbymuchclearertissueboundaryintheimagesandminimized bodyshapedeformationduringtheembeddingprocess.

Key words: VirtualChineseHuman;visiblehumanproject;digitizedvirtualhuman

Thecompletedatasetcontaininghigh-qualitysection images provides the fundamental platformforsophisticated virtualhuman study.Wehavepreviouslyestablished thedatasetofVirtualChineseHumanFemaleNo.1(VCH-F1) withasectionthicknessof0.2mm唯[1]; onthebasis of which the construction of anther dataset, that for VirtualChineseHumanMaleNo.1(VCH-M1),wascompleted with the same section thickness using modified techniquesfromthose employedinthepreviousproject forimprovementoftheimagequality.

MATERIAL AND METHODS

Subject

Forthisdatasetconstruction, weusedthecadaver of a 24-year-oldChineseyoungmalediedofacutefood poisoning, which was preserved at -10 益 within 3 h after death. Voluntary consent was obtained from the relativesoftheyoungsubject todonatethiscadaverfor medicalresearch,andafterstrictquarantineprocedures, the cadaver was measured and scored for the dataset purpose with standardized evaluation system described previously唯[2].

Artery perfusion and body shape finalization

Afterthecadaverwasrinsedat20 益torestorethe body temperature, the artery perfusion solution using themixtureof5%phenol,1%benzoicacidandvermilion starchwas injectedvia the femoralartery 唯[6]暂in a total volumeof1200ml. The cadaver was then sealedina plasticbagandkeptfrozeninsaturatedsodiumchloride solution at -10 益 for 72 h before the embedding procedurewascarriedout.

Specimen embedding

Toguardagainstembeddingreagentexpansiondue to the solidification when frozen that may change the bodyshape, weemployedsubsectionembeddingofthe specimenwithsmashediceblocks.Specifically, the ice blocks of the embedding solution consisting of 1.5 g stainingagent, 1.2 kg glutin and 70 liters water were smashed beforeembedding. Thedetachableembedding mould madeof1-cm-thickaluminous alloy (220 cm伊 58 cm伊38 cm) was fixedonto the baseofthemilling machine to hold the frozen specimen vertically in a upside-downposition.Thesmashedicewaspouredinto the embedding mould to the level of the frontal bone and the spaces between the ice pieces were filled with the embedding solution, followed bya48-hfreezing. The embeddingofthewholebodywascompleted after 8 rounds of freezing by raising in succession the embedding levelfrom the neck, thorax, abdomen, hip, kneeandankle,respectively,supplementedwithfurther freezing for another 5 d. After theembedding mould wasremoved, still another roundof48-hfreezingofthe

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specimenwascarriedout[暂暂].

Specimen milling and image collection

Thedistance allowed forthemovingofthemilling machineontheZaxlewassetat0.2mmforeachsection. Thesectionnumberandlengthmarkerwerelabeledon each section, for which standardized color chart was alsosupplied.AFujiFinePixS2Prodigitalcamerawith Nikkon AF 24/2.8 D lens was used for capturing the sectionimagesataresolutionof3024伊016pixels. A Shanghai T-66S flashlight was used with the guide number of34(ASA100/DIN21)andthewire backtime <3s.Thecolortemperaturewas5500-6000 毅 andthe flashing time setat1/1000s. Synchronous wire triggeringwasadoptedfortheshooting.

RESULTS

General body measurement

The anthropometrical measurements were shown inTab.1,andthereferencestandardswerederivedfrom **Anthropometrical Survey of Chinese**[咱-1(暂]

Tab.1 Anthropometrical measurements of the specimen for establishing Virtual Chinese-Male No.1 dataset

No.	Item	Actualmeasurement	Referencestandard	Conformity	Score
1	Height(cm)	176.00	162.70依.94	伊	0
2	Weight(kg)	68.50	63.95依.63	姨	5
3	Maximumheadlength(cm)	18.90	18.64依.44	姨	5
4	Maximumheadwidth(cm)	16.50	15.92依.71	姨	5
5	Transversecircumferenceofthehead(cm)	57.50	56.52依.14	姨	5
6	Neckcircumference(cm)	39.40	39.89依.97	姨	5
7	Innercanthaldistance(cm)	3.45	3.59依.27	姨	5
8	Outercanthaldistance(cm)	10.04	10.27依.50	姨	5
9	Widthofthenose(cm)	3.92	4.02依.26	姨	5
10	Heightofthenose(cm)	5.34	5.65依.41	姨	5
11	Widthofthemouth(cm)	4.86	4.92依.30	姨	5
12	Chestcircumference(cm)	87.00	85.00依.91	姨	5
13	Waistcircumference(cm)	72.50	75.64依.25	姨	5
14	Fingerlength(cm)	175.51	67.03依.32	伊	0
15	Shoulderwidth(cm)	41.50	40.46依.82	姨	5
16	Pelvicwidth(cm)	28.95	27.52依.55	姨	5
17	Transversechestdiameter(cm)	30.05	28.18依.21	姨	5
18	ChestA-Plength(cm)	22.50	20.00依.85	姨	5
19	Upperextremitylength(cm)	76.00	73.34依.12	姨	5
20	Lowerextremitylength(cm)	95.00	90.14依.70	伊	0
Total					85

VCH-M1 dataset

VCH-M1 dataset consisted of a total of 9 232 images withanapproximatedata sizeof160G.Forthe convenience of different potential users of this dataset, the image datawere storedin3differentfileformatsto allowvariouslyorientedstudies,aslistedbelow:

TIFformat: Resulution3024伊016pixels,161.56 Ginsize

JPG format:Resolution3024伊016pixels,8.31G insize

JPGformat: Resolution180伊20pixels,0.74 G in size

DISCUSSION

High-precision milling is crucial to the establishment of high-quality virtual human image dataset. AfterthesuccessfulconstructionofVCH-F1dataset,we attemptedthefollowingimprovementonthetechniques:

Body shape finalization and specimen embedding

Weusedlow-temperaturesaturatedsodiumchloride tofinalize the body shapeandkeepthewholebodyina natural physiological position. With subsectionembeddingutilizingsmashediceblocks, insteadoftheliquid form, of the embedding solution, we suc- cessfully solved the problem of body shape deformation due to theextrusionoftheembeddingreagentexpansion when frozen, which was somehow obvious in VCH-F1 dataset. Along with this article we present several sample images of diffrent body parts from the dateset (Fig.1-4). Fig.5, 6 shows the sectionimages resulted from differentembeddingmethods.

Phenol and nitrite mixture perfusion

The new perfusion solution we adopted wassterilized and effective to enhance tissue brittleness and retainthenaturalcolorandlusterofthetissues. Inthis dataset the connective tissue tearing was reduced. Sterilizedsolutionnotonlyreducedthe potential health riskonthepartofthestaff, butalsopreservedthefresh color of the muscles and other tissues, which is very helpfulforimageregistration(Fig.7,8).

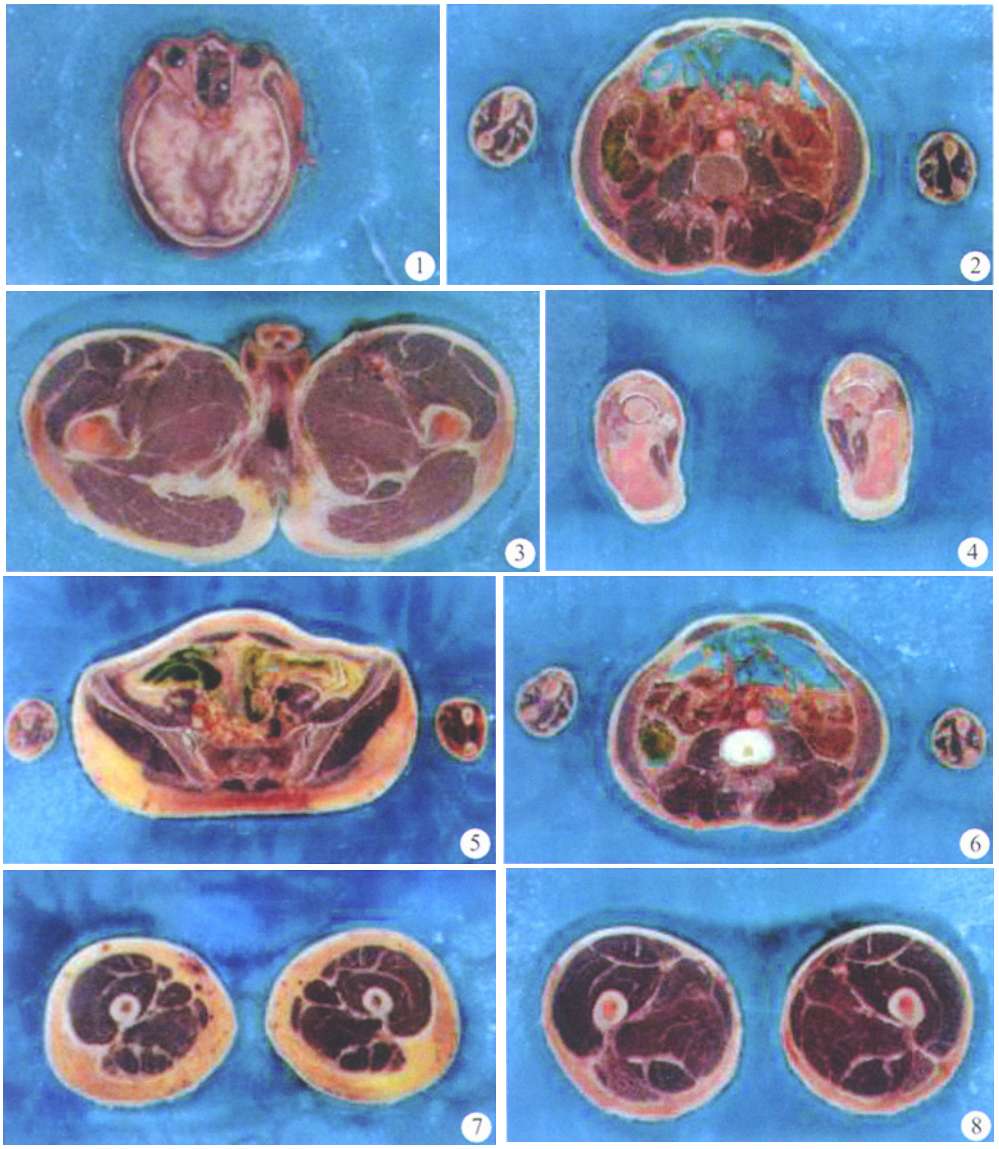

Fig.1 Image of a section of the head Fig.2 Image of an abdominal section
Fig.3 Image of a section of the perineum Fig.4 Image of a section of the ankle
Fig. 5 Image of an abdomenal section in VCH-F1 dataset in which subsection embedding with liquid embedding solution was used
Fig. 6 Image of an abdominal section image in VCH-M1 in which subsection embedding with smashed ice blocks of the embedding solution was used
Fig.7 Section images of fresh and unfixed specimen
Fig.8 Section images of the specimen fixed with phenol

Image labeling

In this dataset each section image was serially numbered and supplied with a standardized color chart and length marker to facilitate later analysis of the images(Fig.6).

Both the VCH-M1 and the previously established VCH-F1datasets[唯暋]werecompletedwiththesectionspacing at 0.2 mm and resolution of 3 024伊 016 pixels, andanthropometricalresults have approved bothspecimenstorepresentstandardChinese [唯-1暋]. Theimproved

techniquesemployedintheestablishmentofthepresent VCH-M1 dataset resulted in higher image quality for latercomputer processing, thereforeoffer a solidfoundationforfutureVirtualChineseHumanstudies.

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虚拟中国人男性一号渊VCH要M1冤数据集研究

原 林袁唐 雷袁黄文华袁李鉴轶袁戴景兴袁刘 畅袁吴 涛袁王兴海袁共辉文袁张美超袁焦培峰袁陆云涛袁吴坤成袁李培良袁樊继宏袁邵 元袁王庆志袁王龙江袁武 雷袁张 磊袁李新安袁陈英华袁欧阳钧袁钟世镇渊第一军医大学解剖教研室袁广东 广州 510515冤

摘要院目的 构建男性虚拟中国人 0.2mm 等间距数字图像数据集袁并通过改进人体标本处理工艺袁提高野虚拟中国人渊男性冤数据集的质量遥方法 材料选自遗体捐献中心袁为食物中毒急性死亡的 24 岁男性袁经石炭酸埋朱砂动脉灌注并低温盐水定型并颈制冰渣倒立包埋并一次装夹并连续等间距铣削等一系列处理后袁采用数码相机照相和计算机自动存储获取数据集遥结果 共获得分辨率为 3024伊2016 象素的断面 9232 片袁TIF 格式数据集容量为 161.56G遥另获 JPG 格式数据集两个袁分别为院分辨率 3024伊2016 像素袁容量为 8.31G曰分辨率 180伊20 像素袁容量为 0.74G遥图像组织边界清晰并肢体变形较小袁断面标记明显遥结论 虚拟中国人男一号渊VCH要M1冤数据集的质量有进一步的提高袁为后续的计算机图像处理和有关应用开发提供了质地优良的基础条件遥

关键词院虚拟中国人曰可视虚拟人曰数字化虚拟人