

# **Dedication**

To my small family for the patience and genuine contribution in making  
me able to achieve this work. **Acknowledgement**

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May Almighty God bless them all. **Abstract**

The aim of this work was to design and implement a simple digital radiography imaging prototype. This prototype is light-tight, pyramid-like structured with dimensions  $30 \times 25 \text{cm}^2$  in the front and  $2 \times 3 \text{cm}^2$  output opening, its length is 40cm. The system is simple, cheap, designed locally utilizing intensifying screen to convert X-rays that pass through patients' body representing patients' body image, converting it into visible light image, and the image captured by charge couple device (CCD) camera that is connected to a computer for image contrast enhancement by removing noise. The prototype designed and tested, many radiographs were taken using classical radiographic X-ray machine, installed in Khartoum Teaching Hospital, Khartoum, Sudan in 2002. The tube used is dual focus, 0.6mm fine focus and 1.2mm broad focus, maximum penetrating power is up to 150 KVP and maximum milliamperere is 500, time start from 0.01second to 5 seconds. Images were taken using tube voltage varies between 60kv and 75kv and the Milliampere/second varies between 10mAs and 28mAs. The obtained images were processed by using wavelet image processing tools, composed of three steps, first, second, third decomposing image into 4 levels with multi-resolutions, selecting initial estimate for threshold, threshold is frequency higher than white light frequency, because most noise has frequency equal to frequency of white light and then suppressing image parts that has frequency lower than threshold, this part contains noise and finally image was reconstructed to original form. A modified system implemented by inserting lens to concentrate light image and camera put at focal distance, images taken showed more enhanced contrast as proved by using five methods for assessing image quality, the five

methods are (1) Histogram equalization (2) Image quality metrics (3) Modulation transfer function (4) Entropy, these four methods used .algorithms and the fifth method by ten expert Radiologists viewing

## □□□□□□□□

الهدف من هذه الدراسة هو تصميم و تطبيق طريقة مبسطة للتصوير الرقمي. تم تصميم نموذج مبسط وهو عبارة عن مخروط ذى شكل هرمي مصنع من مادة خشبية معتمدة لا تسمح بتسرب الضوء , مساحة قاعدة هذا المخروط 25 30 x سم<sup>2</sup> و ارتفاعه 40 سنتيمتر و ينتهي بفتحة 2 3 x سم<sup>2</sup>. و هناك لوحة مكثفة ملصقة على قاعدة المخروط و تعمل هذه اللوحة على تحسس الأشعة التي إختزقت جسم المريض أثناء التصوير وتحولها إلى صورة ضوئية ويتم التقاط هذه الصورة بواسطة كاميرا تصوير فوتوغرافي رقمية مربوطة مع فتحة المخروط و يتم تخزينها في ذاكرة الكاميرا . الكاميرا موصلة مع جهاز حاسوب , حيث تحول الصورة إلى الحاسوب و من ثم تتم معالجتها بواسطة الخوارزميات . تم تصميم و تجربة هذا النموذج بأخذ عدد من الصور بجهاز أشعة تقليدي تصنيع شركة شيمادزو اليابانية سنة 1996 تم تركيبه بـ قسم الأشعة بمستشفى الخرطوم التعليمي سنة 2002 أنبوبة الإشعة التي أستخدمت ذات بؤرتين , بؤرة صغيرة سمكها 0.6 ملليمتر و بؤرة كبيرة سمكها 1.2 ملليمتر . أعلى قيمة لقوة إختراق الجهاز تساوى 150 كيلو فولت و أعلى قيمة لتيار الأنبوبة تساوى 500 ملي أمبير و زمن التعريض يبدأ من 0.01 إلى 5 ثانية . الصور التي أخذت أستخدمت فيها قوة إختراق تتراوح بين 60-70 كيلو فولت و تيار الأنبوبة مضروباً فى زمن التعريض يتراوح بين 10-28 مللى أمبير ثانية. أستخدمت خوارزميات المويجات لمعالجة هذه الصور و زيادة وضوحها. تحتوى المعالجة بإستخدام خوارزميات المويجات على ثلاثة خطوات رئيسية و هي أولاً تفكيك الصورة إلى عشرون مستوى نتج عنها جزيئات متعددة الإستبانة لتسهيل إزالة الضوضاء , و من ثم إختيار عتبة مناسبة والعتبة تردد موجى يكون أعلى من تردد الضوء الأبيض لأن غالبية التشويشات لها ترددات بحجم ترددات الضوء الأبيض و من ثم يتم التخلص من جزيئات الصورة التي لها ترددات أقل من العتبة و هي تحتوى على الضوضاء و الخطوة الأخيرة هي إعادة بناء الصورة الأولية. أضيف تحسين لهذا النموذج بإدخال عدسة لتركيز الضوء والذي يمثل الصورة ووضعت الكاميرا على البعد البؤري للعدسة لإلتقاط الصورة . أخذت صور أخرى و بعد المعالجة أظهرت نتائج ذات وضوح أحسن من النتائج السابقة كما أوضحت خمسة طرق أستخدمت لتقييم جودة الصور وهى (1) خوارزميات المخطط (2) خوارزميات نسيج الصورة (3) خوارزميات تقييم جودة الصورة مترياً (4) خوارزميات تضمين إنتقال

الكفاءة وخامساً بواسطة المشاهدة وتقييم جودة الصور التي قام بها عشرة من الأطباء الإختصاصيين في هذا المجال .

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## List of Abbreviations

	Abbreviation	Details
	ADC	Analog to Digital Converter
	A-Se	Amorphous Selenium
	A Si	Amorphous Silicon
Ba FX:		Flurohalide doped with Europium
	CCD	Charge Couple Device
	CR	Computed Radiography
CMOS		Complementary Metal Oxide Semiconductor
CSI:TI		Cesium Iodide doped with Thallium
	CWT	Continuous Wavelet Transform
	CaWo4	Calcium Tungstate
	DR	Digital Radiography
DAS		Digital Angiography Subtraction
	DQE	Detective Quantum Efficiency
	DWT	Discrete Wavelet Transform
	DAC	Digital to Analog Converter
Gd <sub>2</sub> :O <sub>2</sub> S: Tb		Gadolinium Oxysulphide doped with Terbium
	GEM	Gas Electron Multiplier
	GUI	Gide User Interface
	HgI <sub>2</sub>	Mercury doped with Iodine
	IP	Imaging Plate
	ICU	Intensive Care Unit
ISO		International Standard Organization
	KVP	Kilovolt age Peak
	LCD	liquid Crystal Display
	MAT LAB	Matrix Laboratory
	MR	Mill Roentgen

	MTF	Modulation Transfer Function
	OTF	Optical Transfer Function
		Pb <sub>2</sub> Lead
	PC	Personal Computer
PACS	Picture Archiving and Communication System	
	S/N	Signal to Noise
	TV	Television
	TFT	Thin Film Transistor
	TiO <sub>2</sub>	Titanium Dioxide
	Z	Atomic number
	MSE	Mean square error
	PSNR	Power signal rat