IMPLEMENTATION OF RGB-HS-CbCr SKIN COLOUR MODEL USING MOBILE PYTHON PyS60

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Title : Implementation of RGB-HS-CbCr Skin Colour Model Using Mobile Python PyS60

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Mr. David Bong Boon Liang (Supervisor)

Date

Implementation of RGB-HS-CbCr Skin Colour Model Using Mobile Python PyS60

NGUI LIN HUI

This Thesis Is Submitted To
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Dedicated to my beloved family and friends

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ABSTRAK

Sejak beberapa tahun lepas, para pengkaji telah membuat kajian terhadap pelbagai algoritma dan kaedah dalam mengesan warna kulit manusia. Algoritma ini seringkali diuji and diaplikasikan pada PC. Teknik-teknik bagi mengesan warna kulit manusia selalunya berdasarkan piksel dan juga melibatkan beberapa teknik-teknik pemprosesan imej lain seperti segmentasi warna dan operasi mofologikal. Bagaimanapun, dalam projek ini, konsep penapisan warna dalam ruang warna yang berlainan bersama-sama dengan teknik penggelungan dan penetapan piksel pada suatu imej digunakan dan diaplikasikan pada telefon mobil Symbian OS. Projek ini menekankan pelaksanaan RGB-H-CbCr Model Warna Kulit, yang mengandungi beberapa peraturan untuk mengasingkan bahagian warna kulit manusia dan bahagian bukan warna kulit berdasarkan nilai-nilai piksel di subruang warna RGB, H dan CbCr. Bahasa pengaturcaraan yang digunakan dalam projek ini adalah Mobile Python atau PyS60 dan sumber kod bertulis dilaksanakan pada peranti mobil platform S60, di mana dalam kes ini, Nokia N95 digunakan. Hasil-hasil experimen diperoleh melalui beberapa ujian yang dijalankan dan selepas beberapa analisis; RGB-H-CbCr didapati membentangkan algoritma terbaik untuk diguna pakai dalam mengesan warna kulit manusia, selepas sedikit penyesuaian dibuat.

ABSTRACT

Over the past few years, researchers have come up with various algorithms and method in detecting human skin colour. These algorithms are often tested and applied on PC. The techniques of detecting skin colour are mostly pixel-based and involving few other image processing techniques such as colour segmentation and morphological operation. In this project, however, the concept of colour filtering on different colour spaces along with pixel looping and setting on the image are used and applied on a Symbian OS mobile phone. This project emphasize the implementation of RGB-H-CbCr Skin Colour Model, which consists of a few sets of bounding rules for separating skin colour and non-skin colour region for their pixel values at the RGB, H and CbCr colour subspace. The programming language used in this project is Mobile Python or PyS60 and the written source code is executed on the S60 device mobile platform, which is the Nokia N95 in this case. Experimental results are obtained through tests conducted and after several analyses; it is found out that RGB-H-CbCr presents the best algorithm to be used in extracting the human skin colour, after a slight modification.

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ABBREVIATIONS

HCI	Human Computer Interaction
NCV	Nokia Computer Vision
PC	Personal Computer
OS	Operating System
RGB	Red Green Blue
HSV	Hue Saturation Value
HSI	Hue Saturation Intensity
HSL	Hue Saturation Luminance
ICL	Image Conversion Library
CMY	Cyan Magenta Yellow
CMYK	Cyan Magenta Yellow Black
API	Application Programming Interface
ARM	Advanced Reduced Instruction Set Computer Machine
GUI	Graphical User Interface
QVGA	Quarter Video Graphics Array
IDE	Integrated Development Environment

SDK	Software Development Kit
OSI	Open Systems Interconnection
GSM	Global System for Mobile

CHAPTER 1

INTRODUCTION

1.1 Project Background

Various types of methods and techniques has been implemented over the past few years in extracting the skin portion in an image using algorithm based on digital image processing concepts. Skin colour is very much well-known to be used as a sign in detecting, localizing and determining objects within an image which can sometimes contain skin, like human's faces, arms and legs. The extraction of human skin colour can proved to be very essential in performing image filtering, video compression and colour-balancing.

Applications especially in the fields of Biometric such as human computer interaction (HCI), face-recognition device, large-scale face database and security video surveillance will benefits from this method. This project will review several suitable algorithms concerning colour segmentation in extracting skin colour region from an image. These algorithms will be executed on images on mobile phone using mobile programming language Python for S60, PyS60. The idea of performing this application on mobile phone will surely present a much portable and easier way in detecting the skin colour through the use of camera on the phone.

1.2 Objectives

Below are the objectives of the project:

- To research and explore the different types of skin colour modelling.
- To understand and ensure that the implementation designed is functioning accordingly using the knowledge of RGB, YCbCr and HSV colour space analysis in digital image processing.
- To emphasize the implementation of RGB-H-CbCr Skin Colour Modelling using PyS60 on handheld Nokia mobile platform
- To compare and analyze the different skin colour modelling to that of the RGB-H-CbCr skin colour model

1.3 Project Scope

This project actually emphasize on the implementation of RGB-H-CbCr Skin Colour Modelling introduced by N. Anwar et al. Since the technique used is pixel-based skin detection, which divides each pixel into skin coloured and non-skin coloured individually, it is of an utmost importance in understanding colour imaging concepts regarding the RGB, HSV and YCbCr colour spaces.

The implementation of RGB-H-CbCr Skin Colour Model is also compared with other types of skin classifiers which are also researched and tested. The result obtained from these skin classifying methods are analysed and RGB-H-CbCr is then slightly modified to conform and produce a better result in skin extraction. The algorithm is written using a mobile programming language known as Mobile Python or Python for S60. This written script is applied and executed on S60 handheld device which is of Symbian OS platform based.

Symbian OS is the operating system designed for mobile devices whereas the S60 is the software platform for mobile phones based on Symbian OS. In this project, the Nokia N95 mobile phone is used.

1.4 Problem Statement

Over the past few years, skin extraction techniques varied and they are improved by some of the researchers. The skin extraction techniques can either be used on real-time application or on still image. Many techniques used involve the colour processing methods in different types of colour spaces. These colour processing methods have been applied on computers and never before on mobile phone. Therefore in this project, implementation of different skin colour models are tested and applied on mobile phone platform.

From time to time, researchers have also evaluate the current skin colour models and come up with a better and more accurate skin colour model by either making enhancement or modification. The concept done by those researchers is same as applied in my project where several existing skin colour models are evaluated and then further analysed and compare among each other. The main skin colour model (RGB-H-CbCr) is then modified to produce the best result. However, unlike the previous researchers who apply the concept using either Microsoft Visual C++ or Matlab programming language on computer platform, I plan to bring my project to a whole new level by using a mobile programming language known as Mobile Python (PyS60) and apply it on mobile phone platform (Nokia phone).

1.5 Outline of the Overall Project Report

Basically, the overall project report is divided into five chapters. The five chapters mentioned are *Introduction*, *Literature Review*, *Methodology*, *Result, Analysis & Discussion* and *Conclusion & Recommendation.*

Chapter 1 (*Introduction*) briefly describe the overview, purposes and objectives of the overall project.

In Chapter 2 (*Literature Review*), studies were made and compiled on the types of Skin Colour Modelling done by various researchers as well as information on Mobile Python, Symbian OS and S60 platform on mobile devices. Basic knowledge on digital image processing concerning colour is also explained.

Chapter 3 (*Methodology*) explains the methods and steps used in implementing the RGB-H-CbCr Skin Colour Model, how the design is built; choosing the necessary colour subspaces, performing colour conversion, creating the bounding rules and setting the pixel with conditions applied.

In Chapter 4 (*Result, Analysis & Discussion*), the result and outcome from the overall project will be presented. The different results which produced from some other algorithms of skin colour model will be compared, analysed and discussed comprehensively. Discussion is also made on various analyses and testing of RGB-H-CbCr Skin Colour Model when applies in different conditions.

Chapter 5 (*Conclusion & Recommendation*) summarise the overall performance, the problems faced, as well as recommendations on how improvement can be made and modifications been done in order to produce a much better and desirable results.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

When implementing the Skin Colour Model of RGB-H-CbCr, the concept of colour image processing is applied to obtain the skin region. Therefore, knowledge of RGB, HSV and YCbCr colour spaces are essential. Colour conversion is also an important factor to consider when performing conversion between different colour spaces. Details on Mobile Python PyS60, Symbian OS and S60 platform will also be described at a later part in this chapter.

2.2 Colour Models

In a coordinate system, colour model is known as a set of colour specification or in other words, subspace of a system where every single point is delegated as a colour. Nowadays, colour model is essential in building hardware that is colour-oriented or on any other application in which colour plays a major role or advantage. For common practice, the widely used color model is RGB (red, green, blue), especially in monitor displays or video camera. The CMY (cyan, magenta, yellow) and CMYK (cyan, magenta, yellow, black) color model can be applied in colour-

printing. And finally, HSI (hue, saturation, intensity) model, which can decouples colour as well as gray-scale information in an image. HSI colour model also related closely to how human interpret or perceive the surrounding colour.[1]

2.2.1 The RGB Colour Model

The model is based on a Cartesian coordinate system, with primary spectral components of red, green and blue. According to Figure 2.0, RGB values are located at three corners whereas cyan, magenta and yellow are located at the other three corners. The black is centered at the origin and the white is situated just at the opposite corner from the origin. The dotted line between the two points of black and white represents the grayscale which is made up of points that are equal to RGB values.

The cube shown in Figure 2.0 is known as the unit cube because all the colour values are assumed to be normalised. All the values of R, G and B are said to be located in the range [0,1]. The different colours are situated as points on or inside the cube and are also known as the vectors extend from the origin.[1]

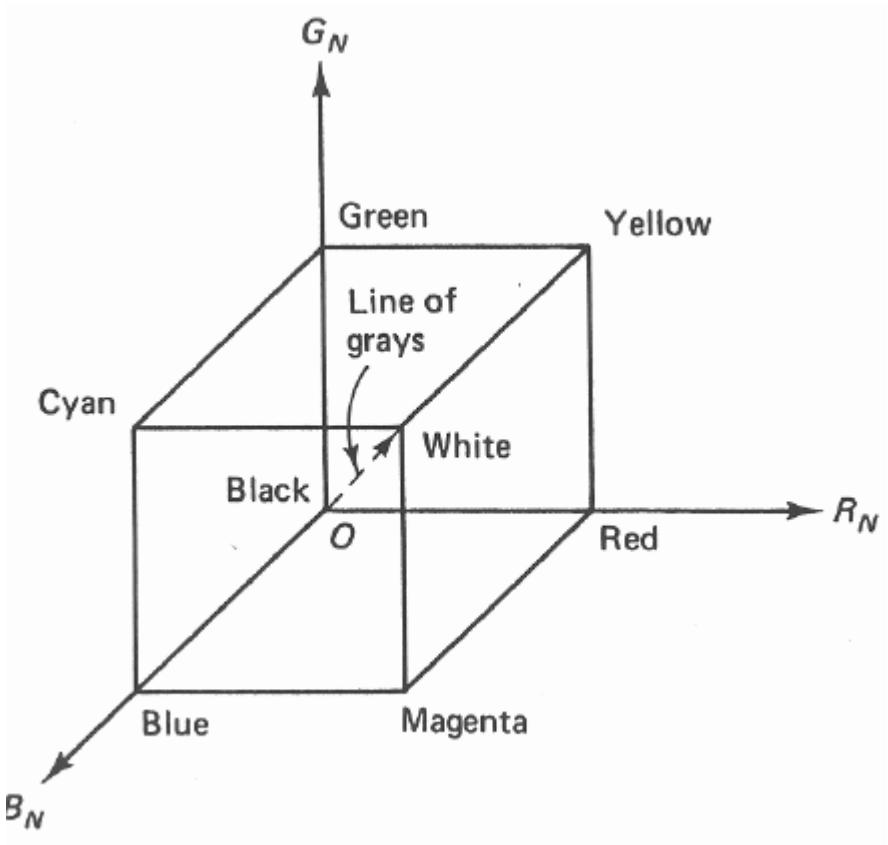

Figure 2.0: RGB colour cube on Cartesian Coordinates [2]

Image represented in the RGB colour model consists of three components, each component representing the respective primary colour. A composite colour image is produced when the three components are combined on the phosphor screen and fed into an RGB monitor. Each pixel in RGB space is represented by number of bits known as the pixel depth. Each of the red, green and blue images is made up of 8-bit in a single RGB image. When this happens, each RGB colour pixel, which is equivalent to a triplet of values of RGB, is said to achieve a depth of 24 bits. A 24-bit RGB colour image is then named as a full-colour image. [1] RGB is perfect for the implementation of image colour generation.