Something about Pool!

Jesper Baekdahl and Simon Have

Supervisor: ??

Dato

Vision, Graphics and Interactive Systems
Aalborg University

Preface

This document serves as appendices for the article published by Baekdahl et al. [1]

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2.1 Pool table specifications

This project will focus on pool tables (pocket billiards). There are many different types of pool such as 8-ball, 9-ball and 14-1. The types differentiate some, but the table and the rest of the equipment is the same.

The international pool regulations concerning table size, cloth colour, ball size and etc. are regulated by "World Pool-Billiard Association". These specifications will be understood in order to know what size of table, ball etc. that has to be looked for while doing the image processing.

In 2.1 a standart pool table is seen from top view. Different indications of pockets etc. are marked.

Figure 2.1: Parts of pool table. From cuetable.com

The, for this project, important regulations are listed here:

- **Playing surface size:**
  Must be rectangular and symmetrical.

9. foot table: 2.54 x 1.27 m.
8. foot table: 2.34 x 1.69 m.

- **Rail size:**
  Must be between 10.16 and 19.05 cm including the rubber cushions.

- **Diamonds (sights):**
  18 diamonds (sights) (or 17 and a name plate) must be attached flush on the rail cap with:
  9. foot table: 31.75 cm from diamond to diamond.
  8. foot table: 29.20 cm from diamond to diamond.
  The center of each diamond should be located 93.5 mm from the nose of the cushion.
  The diamonds may be round or diamond-shaped.

- **Cloth:**
  Only the colors of yellow-green, blue-green or electric blue are acceptable for WPA competition.

- **Ball size:**
  All balls should be 5.715 cm in diameter.
  A complete set of balls consist of:
  Que ball: White
  Solid colors:
  1:Yellow, 2:Blue, 3:Red, 4:Purple, 5:Orange, 6:Green, 7: Maroon, 8:Black.
  Balls with centered band:
  9:Yellow, 10:Blue, 11:Red, 12:Purple, 13:Orange, 14:Green, 15:Maroon

2.2 Image processing

2.2.1 Finding the table

Finding the table is important since this will allow the region of interest to be smaller than the input from the camera. This will also bring down computationtime in several other parts of the project.
There are several approaches that could be used:

- Search for the table as a big rectangle.
- Search for the diamonds that are placed throughout the table.
- Finding the most common colour (the cloth) and then find the outer points of the cloth.

2.2.2 Removing the background

When having to find the balls, their individual position, number and color it will be easier if the background color (color of the cloth) is removed before doing the other operations. This will be done by finding the dominant color in the image which will be the color of the cloth.
This color will be represented in HSV (Hue Saturation Value) which shoule be more light invariant than using RBG or a similar representation of colors.
The following image will be the test image2.2:

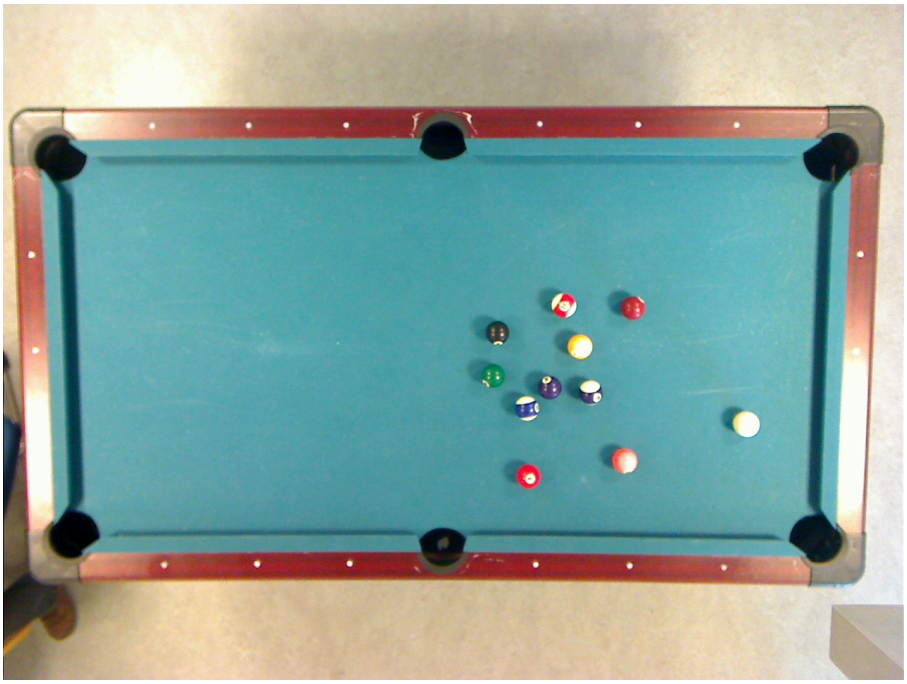

Figure 2.2: Pool table with no image processing done.

A histogram of the image represented pr. pixel in HSV can be seen in 2.3. Two histograms were made. One for the full table and sourroundings, and one for only the cloth.

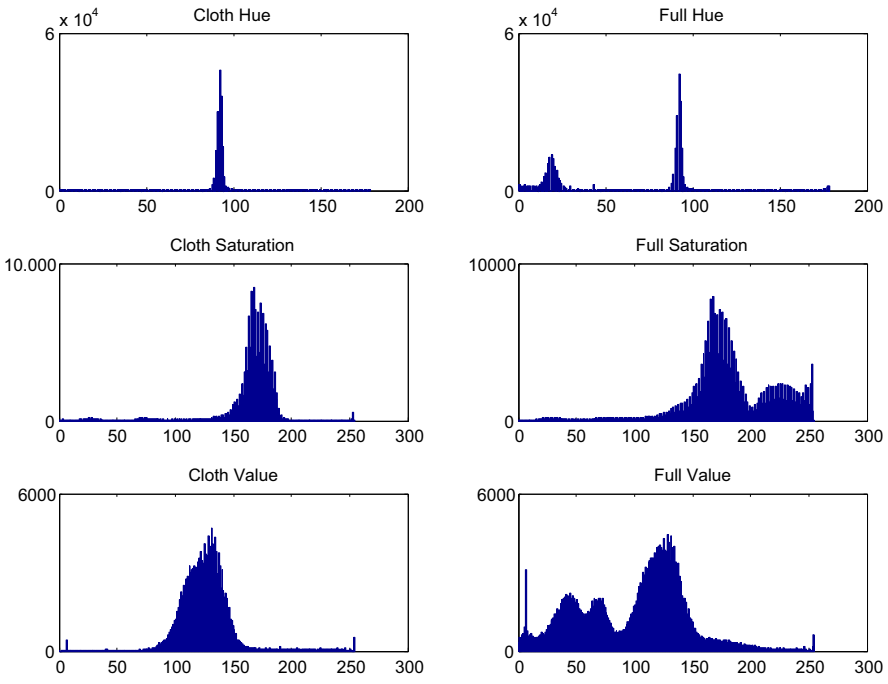

Figure 2.3: Histograms of cloth only and full table in HSV.

As it can be seen it should be possible to subtract the background without removing too much information about ball location etc. The hue is very easily identified where the saturation and value are broader peaks. The most common values, calculated in the software, of HSV are (92,129,168) which the histograms also indicate.

By using the following filter we can subtract the pixels in the image that are close to the most common values, more specificly the pixel is identified as being a part of the cloth if following conditions are fulfilled:

Hue is +/- 10 of most common hue-value.
Saturation is +/- 50 of most common saturation-value.
Value is +/- 50 of most common value-value.

The output from this operation can be seen in image2.4.

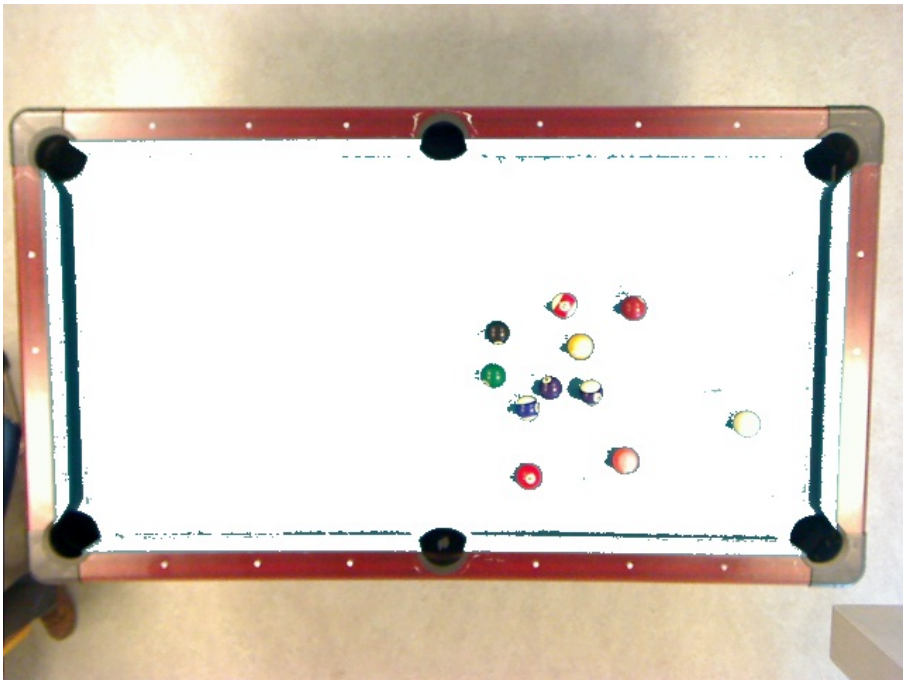

Figure 2.4: Pool table with cloth removal.

Bibliography

[1] Jesper Baekdahl, Rolf Madsen, Mikkel Thesbjerg, and Simon Have. Real-time marker-less drift-free orientation estimation. International Journal of Computer Vision, 81:128–137, 2009.