# IDENTIFICATION METHOD OF ROOTS THROUGH DIGITAL IMAGE SEGMENTATION

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***Abstract****. This work aims to develop a software for digital image analysis of washed roots. The algorithm used in the segmentation process, whose purpose is to distinguish the roots of the rest of the image, is given. For the development of the software it was used Java with Intel's OpenCV library©, and Netbeans IDE development tool. To test the software it was used an image of soybean roots. The visual result shows that the developed software can be promising for the detection of a root image.*

***Keywords.*** *Segmentation, JavaCV, OpenCV, Algorithm, DIP.*

## 1. INTRODUCTION

The digital image processing (DIP) is a computational method, which aims to extract data and information a particular image. DIP can be used for two categories [5]: (i) refinement of information for human interpretation (image processing), and (ii) automatic computer examination of information extracted from a scenario (image analysis, computer vision and pattern recognition).

One of the first steps in image analysis is the image segmentation. The purpose of the segmentation is to isolate, in another image, the part of the interest of the image [6]. With technological, computer evolutions and from possibility to extract information of objects such as their measure, and be or not in the default pattern, the DIP generated interest in many different fields such as medicine, engineering materials, metallurgical among others [7]. DIP has also been applied in agronomy, for image analysis of seed and leaves, and in particular in the study of the root system of plants.

Bohm [3], describes the classical methods of analysis of roots. He says that the difficulties in root system analysis have been of the methodological nature since the existing techniques are tedious, time consuming and rarely presents an accuracy that is considered adequate. Given these difficulties in the analysis of plant root systems, computational systems have been lately demonstrated. In the case of computational solutions for analysis of washed roots and soil profile, Crestana et al [4] present the software SIARCS which allows qualitatively and quantitatively evaluate the distribution of roots, eliminating much of the subjectivity found in the manual methods, and improving accuracy in analysis.

This study aims to develop software for analysis of digital images of washed roots, seeing for technological advancement in this agricultural area. More specifically, this paper presents the results of the first part of the software, segmentation, whose goal is to distinguish the roots of the rest of the image.

Besides this Introduction Section, Section 2 describes the material used on this work and the reasons for their choices; Section 3 explains the methods used and gives the description of the experimental setup; Section 4 shows and explains the results obtained with the experiments and finally, on Section 5, there is the conclusion about this work.

## 2. MATERIALS AND METHODS

### 2.1 Image

To perform the experiment, we obtained an image scanned from soybean roots, provided by the Laboratory of Plant Nutrition - UEPG, Figure 1, which was saved in RBG (Red, Green, Blue) color space and JPEG format. The image has dimensions of (352 x 215) pixels.

**Figure 1: Initial image used from soybean roots.**

### 2.2 Technologies

To build the software for analysis of digital images of washed roots we used the same technologies used by Name et al [11]; Name et al [12]; Name et al [13]. So, we have used the free platforms Netbeans 6.9.1 Oracle, OpenCV version 2.4.0, and javacv 0.1 running on an Intel ® Core ™ i5 650 3.20 GHz, 4.0 GBs of RAM and operating system Windows 7 32-bit.

The library OpenCV (Open Source Computer Vision) [10] was used for digital image processing [8]. However, for its functions be accessed by code in Java language, it was necessary to use the JavaCV plugin [2]. More specifically, this plugin implements various existing functions in OpenCV, which are accessed via JNI (Java Native Interface). According to [1], JNI serves as a bridge between Java and native part of an application, providing functionality for communication between the parties. Also, it is included in the JDK, tools for mapping methods and Java data types to C/C+ +. We also have chosen these items to get free tool platforms, using as a prerequisite the Java language.

The methods used were the library OpenCV cvFindContours(), cvDrawContours() and cvBoundingRect(). From these OpenCV methods and Figure 1, we applied the software to identify the roots through segmentation methods.

## 3. RESULTS

The developed algorithm is presented below.

**Algorithm 1** – Algorithm of method pintarObjetos()

```
1:  public static IplImage pintarObjects (IplImage imagem, int
    limiar){

2:              IplImage pintado=imagem.clone();
3:   CvSize cvSize = cvSize(imagem.width(),
    imagem.height());

4:  IplImage copia=cvCreateImage(cvSize,8, 1);

5:  cvThreshold(Imagem.converterImagemParaCinza(imagem),
    copia ,limiar, 255, CV_THRESH_BINARY);

6:   cvNot(copia,copia);

7:  CvMemStorage memoria = CvMemStorage.create();
8:  CvSeq contornos = new CvContour(null);
9:  cvFindContours(copia, memoria, contornos,
    Loader.sizeof(CvContour.class), CV_RETR_EXTERNAL,
    CV_CHAIN_APPROX_NONE, new CvPoint(0,0));

10: CvSeq ptr = new CvSeq();
11: int cont =0;

12: CvPoint p1 = new CvPoint(0,0), p2 = new CvPoint(0,0);

13: CvScalar cor_contorno = null;

14: for (ptr = contornos; ptr != null; ptr = ptr.h_next()) {
15:       CvRect quad = cvBoundingRect(ptr,0);
16:       p1.x(quad.x());
17:       p2.x(quad.x()+quad.width());
18:       p1.y(quad.y());
19:       p2.y(quad.y()+quad.height());
20:      cor_contorno=getCor();
21:      cvDrawContours(pintado, ptr, cor_contorno,
    CV_RGB(0,0,0), -1, CV_FILLED, 8, cvPoint(0,0));
22:      cvDrawRect(pintado, p1, p2, CV_RGB(255,0,0), 0, 0, 0);
23:    cont++;
24:   }
25: return pintado;
26: }
```

The Algorithm 1, shows the data structure IplImage type, receives as parameter the structure and threshold value (line 1), clone the image to the same type and create an empty image (lines 2 to 6), and then performs the following steps: structure creates memory storage (line 7), creates structure sequence outlines (line 8) and applies the method of searching for contours (line 9). Subsequently, an iteration contour starts getting the coordinates of the contour previously obtained and draw the outline of the object found and rectangle around from its centroid (lines 14 to 24).

After, the image (Figure 1) is loaded in the developed software. It provides, for a pre-selection of parts of interest in the image, a slider bar that includes the RBG channels, Figure 2.

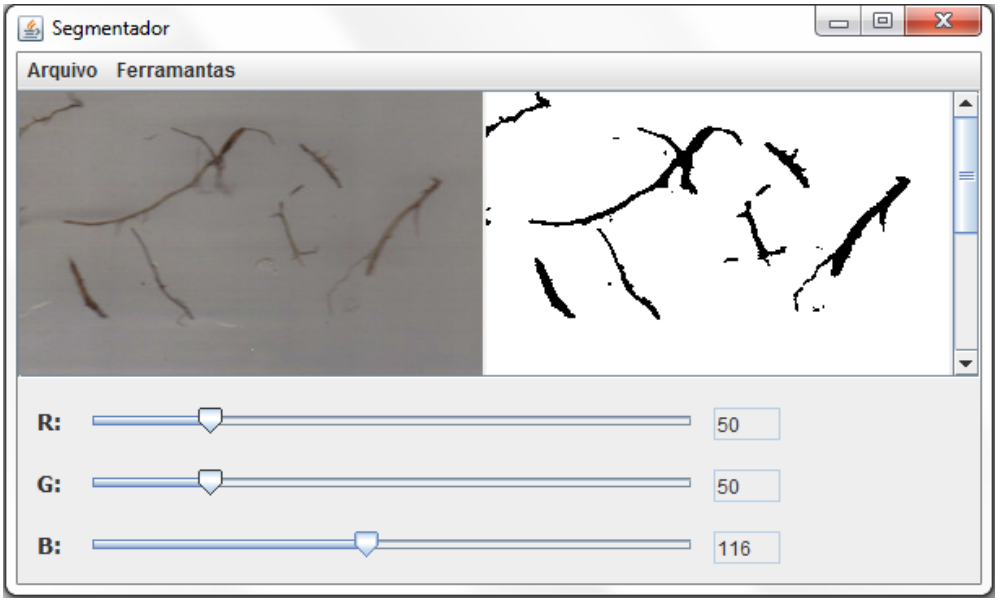


**Figure 2. Interface to change the values of the RGB channels to select parts of interest of the roots.**

By leaving the channels R and G with value of 50, and the B channel with value of 116, due to the fact that this channel presents greatest changes in this image, leaving or not the details of the image, we applied the methods of segmentation.

Figure 3 presents the results after the use of segmentation algorithm.

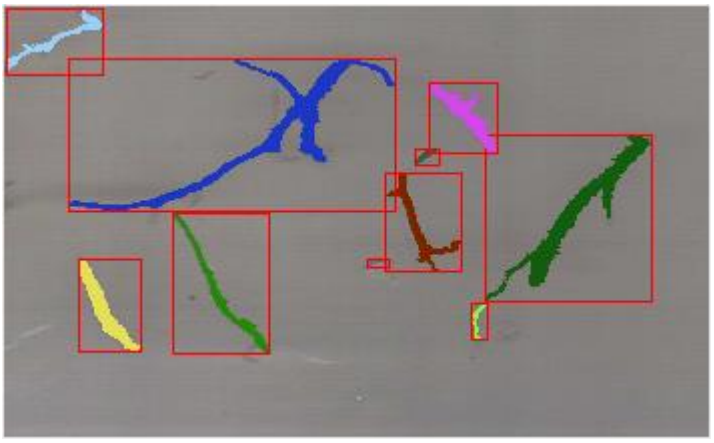

**Figure 3. Presents the results after the use of segmentation algorithm.**

As can be seen in Figure 3, ten roots were found and each one was randomly color assigned. The color attribute was set for each root to verify if the developed system was not only able to identify objects, but also individualizes them. Therefore, it can be obtained parameters from the individualized object as the total area, as demonstrated by the software of Name et al [12]; Name et al [13].

## 4. CONCLUSIONS

We developed software for detection of roots in an image using the segmentation technique through image analysis. The advantages of using a computer program for this purpose are: the method is not destructive, and it avoids human subjectivity.

At the end of the research, the objective is to have software that assists in the process of quantification and measurement of crop root systems, commonly used in agriculture. The final system can also reduce the time of determination of the root parameters, and, with some improvement, it can be extended for use in other areas of knowledge.

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