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EFFECTIVE IMAGE PROCESSING TECHNIQUES FOR THE PROSTATE DIAGNOSTICS

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ABSTRACT
Image processing is a powerful Technique for increasing the reliability and reproducibility of disease diagnostics. In the hands of pathologists, image processing delivers measurable information from images which supplement the qualitative data recently used by specialists. In this research study the abnormality of the prostate using image matching techniques to compare the volume of the a reference normal case and patient abnormal prostate enlargement volume case, in order to compute the two volumes overlap ratio that gives an approximate amount of prostate volume enlargement and as a diagnostics tool, so doctor can measure patient prostate irregularity using this approach after overlapping and matching volume enclosed by patient abnormal case with volume of the normal case as reference value taken into consideration both age factor and the body mass index BMI. Furthermore, this paper also implement a statistical analysis by computing average, standard deviation and variance differences respectively between patient image and reference image average, three difference outcome exact amount of prostate enlargement, which will be represented as a percentage that indicate the amount of the prostate enlargement

Keywords: Image Prossing, System Dignostics, Prostate Dignostics.

INTRODUCTION
Most men after the fifth decade experience symptoms or have histology consistent with prostate growth and Benign Prostatic Hyperplasia (BPH) where the normal size of prostate gland is about the size and shape of a walnut or golf ball [1-3]. When enlarged, the prostate may obstruct urine flow from the bladder and out the urethra. Comparing normal and enlarged prostate glands for different ages & taken into account Body Mass Index (BMI) which measure body fat based on height and weight that applies to adult male [6]. Figure1. Illustrates the size of the prostate varies with age [2-5]. In normal adults, the prostate is about the size of a walnut, but it can become significantly larger in older men. Around the age of 40, the prostate gland tends to enlarge as the result of a condition called BPH [7-9]. A healthy adult prostate weighs about 20–25 grams (2/3 to 3/4 of an ounce). BMI is a measure of body fat based on height and weight that applies to adult male, there is a relation between prostate size and weight where the prostate volume would increase if BMI is greater, and in this research BMI calculated using equation1 [10-11]:

$$\textbf{BMI} = \textbf{Weight} / (\textbf{height})^2 \qquad \textbf{Kg/m}^2 \quad \textbf{.....(1)}$$

Prostate volume significantly increased approximately 25% from the lowest class-1 to highest class-4 according to given BMI categories, for example an **age 20** average male of class-1 has a prostate as the volume of a walnut approximately **10 cm^3** while class-4 male of same age normally has a prostate volume almost 25% greater than male of class1 which is approximately **12.5 cm^3.** The BMI classes illustrated in table 1

Table1. BMI categories

Classes	BMI Value	Weight category
Class 1	<18.5	Under weight
Class 2	18.5-24.9	Normal weight
Class 3	25-29.9	Over weight
Class4	Greater than 30	obesity

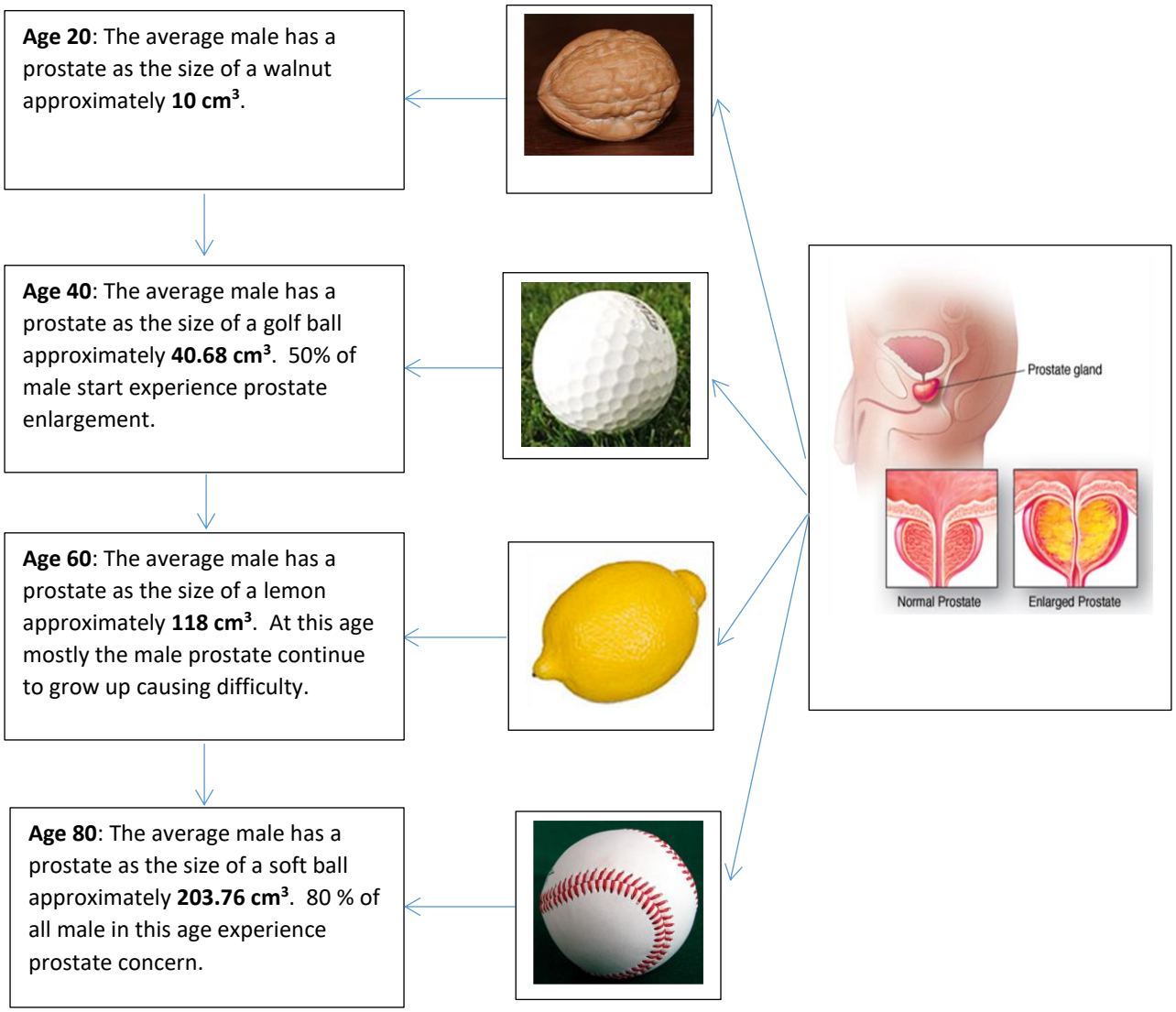

Figure 1: The Prostate volume changes with age life cycle

METHODOLOGY

In this research recognition technique based on matching between a normal reference image and the patient abnormal prostate raw image in order to find out the difference between them in volume which represents the percentage of prostate volume enlargement. There is a preparation stage to obtain a suitable pattern to be matched for both the reference and the measured. Figure 2; illustrate a prototype model to measure the prostate volume enlargement, taking into consideration different age indices and BMI.

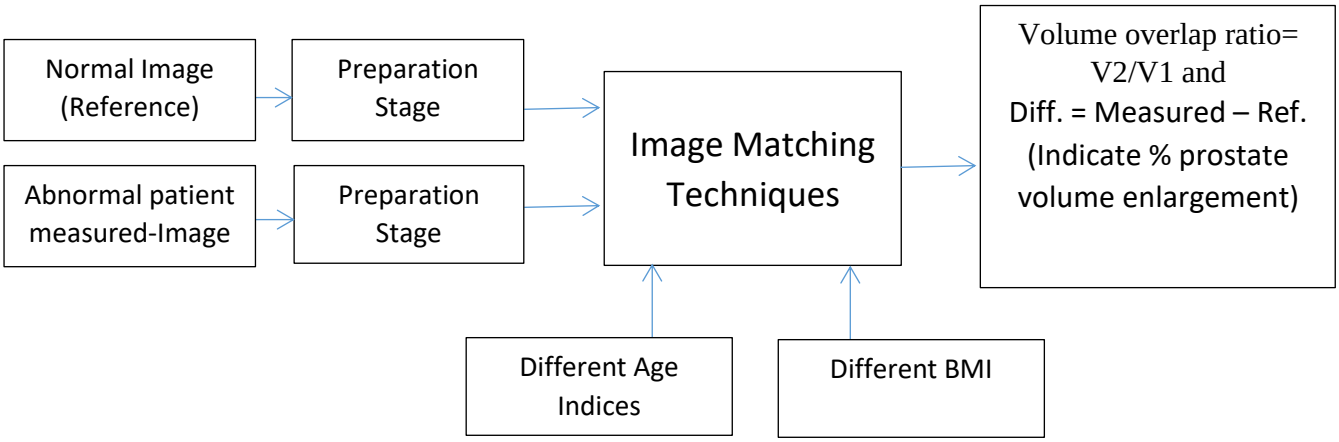

Figure 2: Image matching model to measure prostate volume enlargement.

The following mathematical background illustrate Implemented volumes ratio and statistical Analysis used in research Methodology

- Volume measure of the space enclosed by the normal prostate boundary given by V1 as reference value taken into consideration age & BMI factors as illustrated by life cycle ;
- Volume overlap ratio= V2/V1, ratio represent approximated percentage of volume irregularity, where V2 is the volume enclosed by patient abnormal case divided by the volume of the normal case as reference value V1 ;
- Average Difference = patient image average – reference image average
- Let $X_1, X_2, ..., X_n$ be n observations of a random variable X. We wish to measure the average of $X_1, X_2, ..., X_n$ in some sense. One of the most commonly used statistics is the mean, μ_X, defined by the equation 2

$$\mu_X = \bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \quad \text{..... (2)}$$

- The mean value formula used for reference and measured images given by following Mat Lab code by **A = mean (u (:)) …… (3)**
- Next, we wish to obtain some measure of the variability of the data. The statistics most often used are the variance and the standard deviation $\sigma_X = \sqrt{\sigma_X^2}$.

  We have

$$\sigma_X = \sqrt{\frac{1}{n}\left\{\sum_{i=1}^{n} X_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} X_i\right)^2\right\}} \quad \text{..... (4)}$$

The standard deviation for reference and measured images given by following Mat Lab
D = std (u(:)) …… (5)

- It is easy to show that the variance is simply the mean squared deviation from the mean.
- Standard deviation difference = patient image STD – reference image STD
- Variance difference = patient image variance – reference image variance

Above Volume overlap ratio Indicates amount of prostate volume enlargement diagnostics, so doctor can measure patient prostate irregularity using this approach after matching volume enclosed by patient abnormal case V2 with volume of the normal case as reference value V1 and statistical differences analysis illustrate exact amount of prostate enlargement.

Mat Lab image processing toolbox used to calculate the volume of unshaped object obtained by using the object and background in image, part of code given in Figure 3, so main objective is to calculate the volume of object represented by V2 in order to obtain the ratio with reference value V1 which represents approximated percentage of prostate irregularity. While Figure 4 illustrates the preparation stage implemented as sequential algorithm steps with outcomes images for each step to prepare measured image for Mat lab before estimating volume ratio & other statistical analysis.

Step 1: Read original Prostate Image.
Step 2: Convert gray to binary scale.
Step 3: Clarify image using Vertical-Horizontal structuring.
Step 4: Filling interior gap.
Step 5: Removing Connected object borders.
Step 6: Smoothing object using segmented image.
Step 7: Outline final image ready for matching process

```
Object = im2bw(I); % where '1' labeled by white on
the object and '0' as black on the background as
shown in last stage of figure 3

Volume2 = length (find (Object == 1));
```

Figure 3. The implemented Mat Lab code used to calculate volume

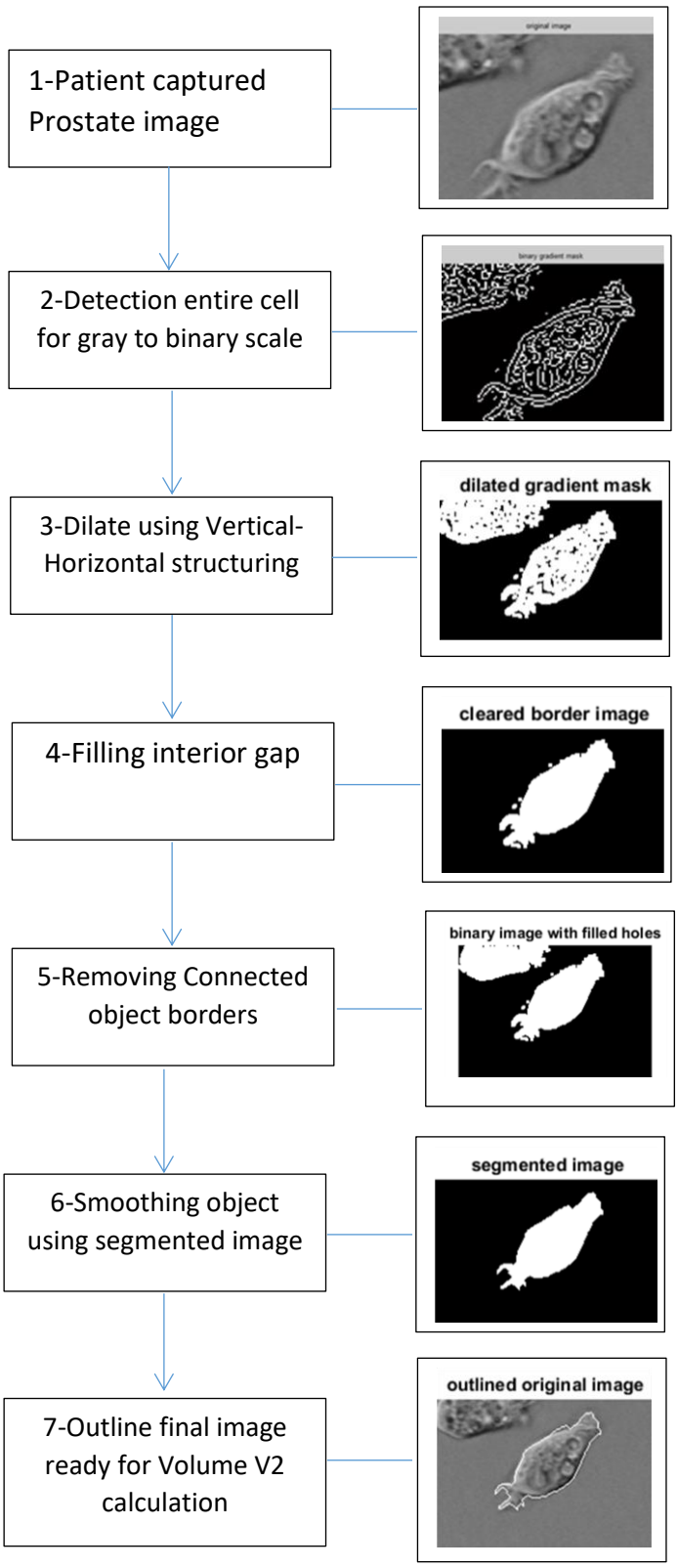

Figure 4: Flow chart of Image preparation steps & outcomes for matching process

PROCESSING TIME

In this techniques were all processed on an Intel® Coren12 Duo T9300 2.5 GHz processor with 8GB RAM and 32-bit operating system using MatLab R2010B Student Edition. Execution is the average execution time in seconds for processing 700 x 700 pixel photomicrographs representing each of the staining combinations over the three grades of inflammation (none, moderate and severe). On all counts, the proposed method was slightly faster than the old method. The proposed method performs size and shape analysis for each detected prostate, and its execution time, thus, is a function of the number of prostate present. Such as, computation time varies directly with the rate of infection. In this method and the Thomas method: where the Otsu and the Thomas methods execute in a fraction of a second, the JSEG methods average execution time is nearly a minute.

CONCLUSION

The present study introduces a significant and effective method to measure the abnormality of the prostate using image matching techniques to compare the volume of the a reference normal case and patient abnormal prostate, where ratio V2/V1 represents the amount of prostate enlargement, Mat Lab code implemented to compute the two volumes then overlap ratio calculated that gives an approximate diagnostics of prostate volume enlargement, taken into consideration both age factor and the body mass index BMI. Also present research measures the exact patient prostate irregularity using a statistical analysis by computing average, standard deviation and variance differences respectively between patient image and reference image, three differences represent the exact percentage amount of prostate enlargement.

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