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Urine Crystals Classification Using Image Matching Method

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ABSTRACT

The Crystalline Salts classification is important for the diagnosis of pebbles in human kidneys. The aim of this study, classified and diagnosed the Urine crystals by using a computer program.

In this study, 128 samples, these samples consist of monocrystalline oxalate crystals, ammonium chlorate crystals and cysteine crystals. The sixty samples of crystal crystals were collected to have twenty for each of the types of crystals mentioned above. They were later classified into different groups depending on the difference in form and size. The method of matching image was applied to obtain the results of classification of crystals management which reached 98%.

1. INTRODUCTION

Early diagnosis of any illness helps obtain early recovery, and thus the possibility of avoiding many of diseases becomes higher. The role of this operation is becoming increasingly important as technology advances in computer imaging that can produce large amounts of data to be interpreted to make a decision in the diagnosis of diseases effectively and quickly [1].

Pattern Recognition is a computer programming technique, which is a problem-solving one for software engineering. It is a branch of computer science mostly related to artificial intelligence [2]. The research in and the techniques used in this science aim at finding or developing techniques to identify specific patterns or structures in digital signals. A signal can represent an image that contains a written letter, music or speech that represents a word or a computer text [3].

1.1 Urine

Urine is considered as one of the body fluids, which is extracted by the kidneys from the human blood, and then excreted through the ureter to reach the bladder to be later casted out of the body via urethra [4]. This process helps get rid of excess salts and water in the body. A healthy person's Urine is usually yellow in color; however the urine color might change due to proportions of water and solid materials in it [5].

1.2 Types of Urine Crystals

A) Acid Crystals: they are formed in acidic media, such as:

- Uric Acid Crystals: they are found in various forms, often yellowish-brown.
- Amorphous Urine: they appear in the form of granules scattered in the diuresis and take a brown color.

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- Calcium Oxalate: they are crystals that appear in colorless diuresis in many forms. They are of two types [4]:
  - Monohydrate: the shape of the crystal is close to Dumbbells.
  - Dihydrate: octahedral (form of envelope letters) that is the most common.
- Cysteine Crystals: Its presence in the diuresis indicates an abnormal condition and often has a colorless, thin, hexagonal shape.

B) Alkaline Crystals: they are crystals formed in the basal media. Common crystals in Alkaline are [5]:

-Triple Phosphate Crystals: they usually appear as a "casket cover". Triple phosphate crystals consist of ammonium, magnesium and phosphate.

-Amorphous Phosphates: they are similar to amorphous Urines except that they are colorless.

-Ammonium Burien Crystals: they have a yellowish brown color, and take a spherical shape.

-Calcium Carbonate Crystals: they are colorless, and take the form of Dumbbells.

2. IMAGE PROCESSING

Digital image processing is very important in the field of image perception when trying a computer or a robot that understands an image. It is also important in the field of recognizing patterns or shapes. Pattern recognition is of great importance in the automated processing of an image taken by a digital camera, and the image is treated as a signal. Digital processing methods are applied to the signal through filters to identify patterns or objects within the image. [6]

Digital Image Mapping is the process by which digital image data is analyzed automatically by establishing quantitative rules and systems based on the values of multiple spectral radiations (symmetric radiations). [7]

2.1. Image Matching Method

Some of the basic methods used in Pattern Recognition are [8]:

-Template-Matching and Correlation.

-Statistical Approach.

-Syntactic and Structural Approach.

-Neural Networks Approach.

2.2 .Template-Matching Method

The learning phase of this model is based on the storage of a number of templates, were represents an item in the computer. Figure (1) shows the templates stored in the computer for comparison with templates entered for the purpose of distinguishing them [9].

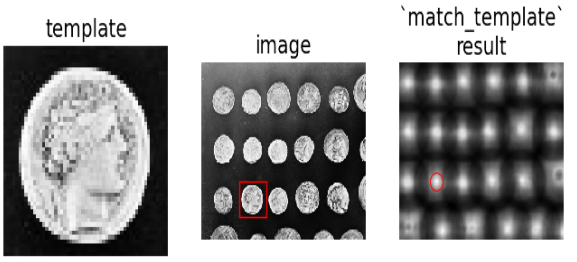

Fig. 1: The input templates to be distinguished with the templates stored inside the computer

The comparison image (at the classification stage) is compared with the items stored separately. The degree of difference exceeds the *threshold value*, it means that the two images are not the same and the opposite means that the two images are similar or identical. This method was used to distinguish printed letters and to read bank instruments [10]. Figure (2) shows the computerized classification process.

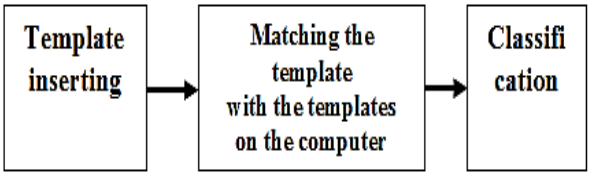

Fig. 2: Classification by Compute

2.3.The Correlation

The Correlation is one way to detect similar values of an area in the image. The following equation is used to calculate the correlation R for any value of (m, n) inside the image f (x, y). [11]

$$R(m,n) = \frac{\sum_x \sum_y [f(x,y) - \bar{f}(x,y)].[w(x-m,y-n) - \bar{w}]}{\sum_x \sum_y [f(x,y) - \bar{f}(x,y)]^2 . \sum_x \sum_y [w(x-m,y-n) - \bar{w}]^2]^{1/2}} \quad \dots (1)$$

Where $\overline{f}(x,y)$ is the mean value of pixel of f(x, y) image, and $w(x-m,y-n)$ is the sub-image or part that found in f(x, y) image $\overline{w}$ is the mean value. The source image is then scanned using the mathematical convolution process as shown in Figure (3) [12].

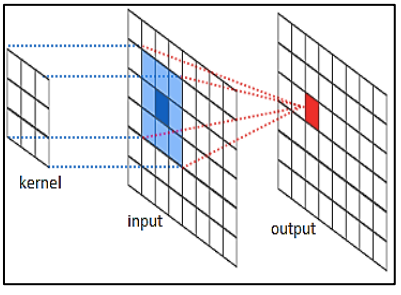

Fig. 3: Using Mathematical convolution to scan the image

3. PRACTICAL PART

3.1. Samples Preparation and Images Obtaining

Human Urine samples were prepared on a glass slide (Samples were taken at Al-Numan Teaching Hospital in Adhamiya, Kamal Al-Samarrai Hospital and Dahlik Health Center). Human Urine Samples were preparation of glass slides were done in medical laboratories. A digital image by slides was obtained under an optical microscope and of appropriate resolution as it was taken using a digital camera directly connected to the computer, as shown in Figure (4).

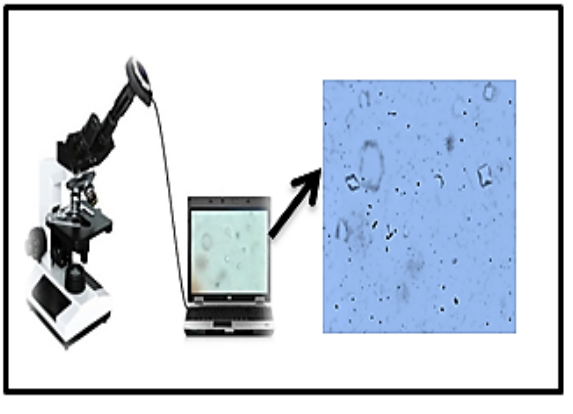

Fig. 4: Image Capture with a digital camera fixed on an optical microscope with image (human urine) of 400x.

3.2. Classification Results of Matching Method

The images and extracting the crystals, as shown in Figure (5), they were used for matching. The images extracted and used as a model in the classification were stored images of crystals extracted from the program and the number (182). It was observed that there was a matching between the images to be classified with the database of images previously stored in the computer through the matching program shown in Figure (6).

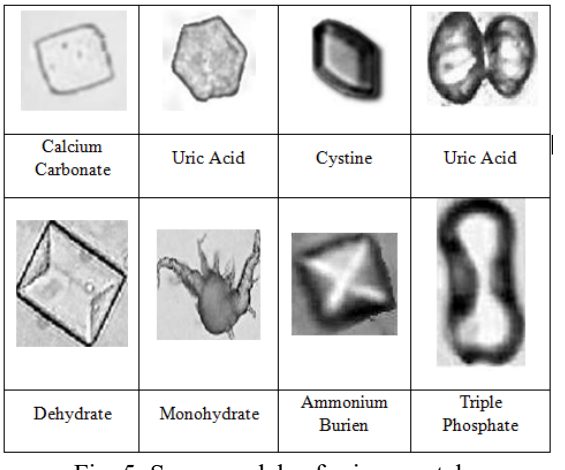

Fig. 5: Some models of urine crystals

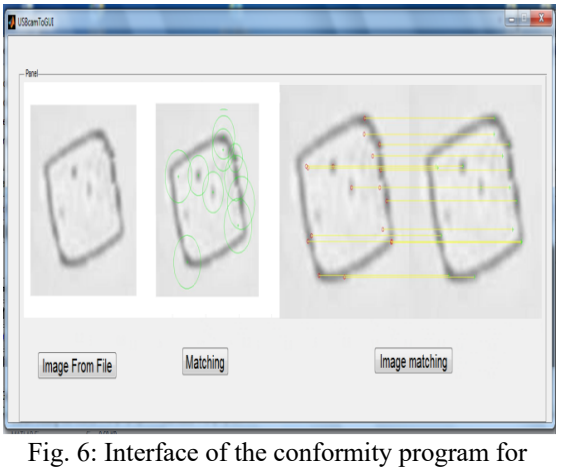

Fig. 6: Interface of the conformity program for classification of urine crystals.

The image of the crystal to be categorized and compared with the database is request for images previously stored in the computer, by finding the matching characteristics of regions or points in both

images, as shown in Figure (7). If there is no match, the phrase "No match" appears as shown in Figure (7). If there is matching, the image displayed in Figure (8).

4. DISCUSSION AND CONCLUSIONS

The classification accuracy using the current image matching method was 98%. It requires the development of all forms or categories of possible crystals in the urine, so that the program and the computer can identify the crystals and filter them according to that database. The proposed program is inexpensive, easy and does not require long training. Accordingly, this study recommends the use of this program for processes of image matching.

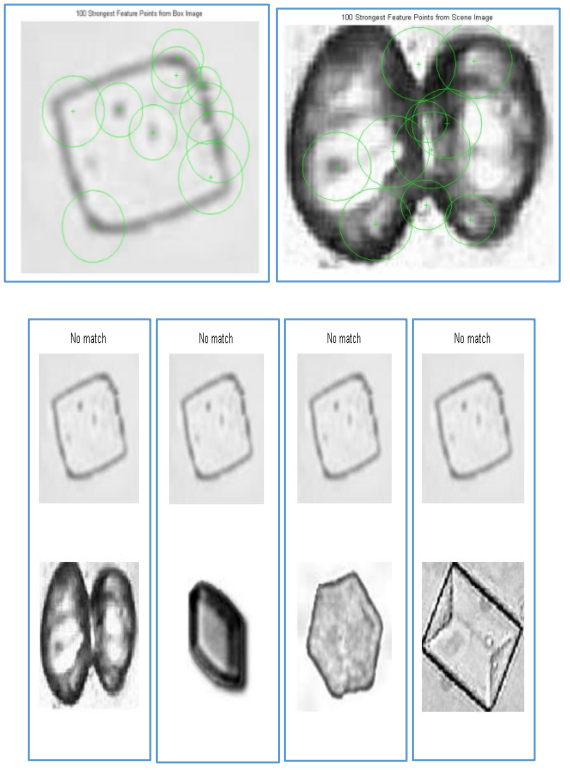

Fig. 7: Modeling of interest areas for image of crystals to be matched

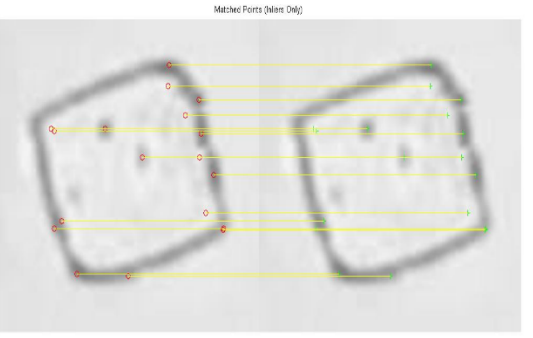

Fig. 8: Matching the images with the database image stored

5. RECOMMENDATIONS

-The proposed program can be applied in diagrams urine analysis labs.

-Rotate the sample (image) to be classified at a certain angle appropriate to the position of blouses stored.

-Solving the problem of interference and contact with crystals by one of the methods of image processing, as it was not solved in this study.

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تصنيف بلورات الإدرار باستخدام طريقة التطابق الصوري

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الخلاصة:

يعد موضوع تصنيف بلورات أملاح الإدرار مهم لتشخيص الحصى في كلى الإنسان. في الدراسة الحالية، تم تصنيف بلورات الإدرارباستخدام برنامج يعمل على تشخيص بلورات الإدرار (في مختبرات التحاليل الطبية). في هذه الدراسة؛ تم التقاط 128 صورة لعينات الدراسة المتكونة من بلورات أوكسالات الكالسيوم الأحادية وبلورات بيورات الأمونيوم وبلورات السيستين، من اختيار 60 بلورة من البلورات المستخلصة منها بواقع 20 بلورة لكل نوع من أنواع بلورات الدراسة الآنفة الذكر، ومن ثم تصنيفها إلى مجاميع متنوعة بالاعتماد على الاختلاف بالشكل والحجم وتطبيق طريقة التطابق الصوري والحصول على نتائج تصنيف بلورات الإدرار تصل إلى 98%.

الكلمات المفتاحية: التطابق الصوري، بلورات الإدرار، معالجة الصور الرقمية، ماتلاب.