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Recognition of coordinate in the scanned maps for automated Georeferencing by Bezier curves and supervised learning

A. Kerkour Elmiad[1]*, M. Hassani Zerrouk[2]

[1] Laboratoire de Recherche en Informatique, Faculty of Sciences and Technology of Al Hoceima, University Mohammed 1er, Morocco.

[2] Laboratoire de la Recherche et du Développement en Sciences de l'Ingénieur

**Corresponding Author: mid.kerkour@gmail.com*

In this project, we can see how to add georeferencing to scanned maps and aerial photos so that their value can be multiplied through association with other data. Where good georeferenced control layers can be found, the process of georeferencing an image is surprisingly easy.

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Training

Introduction

Recently, a lot of work has been done by computer function; In order to allow processing time to reduce and provide more results that are accurate, for example, depending on different types of data, such as characters and numbers and numbers are used frequently in the normal functioning of life . In order to automate systems that deal with numbers such as zip code, bank account numbers and numbers on car plates. And an automatic recognition of coordinates in the system of digitized maps is proposed in this study. Recognition of the numbers has been extremely found and studied. Various approaches in image processing and pattern recognition have been developed by scientists and engineers to solve this problem [1-2]. This is because it has importance in several areas and it can probably be used in checks in banks or to recognize numbers in plate cars, or other applications.

The proposed system recognizes coordinates in digitized maps as a system to acquire an image made up of numbers, then the image will be processed in several phases such as image enhancement, slimming, skeletonaization and front segmentation To recognize the number. A multi-layer neural network is used for the recognition phase; A back propagation algorithm will be applied for the formation of the network and finally change them into digital text [3].

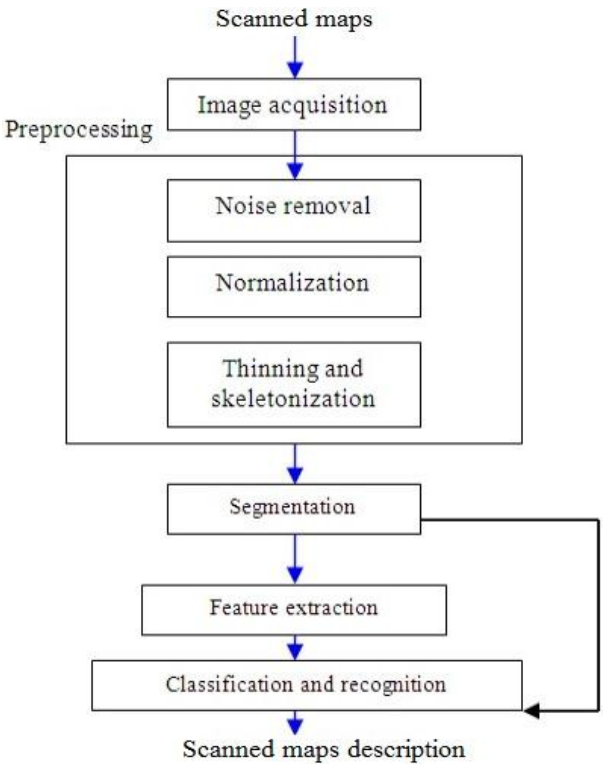

Fig. 1: A general diagram for Arabic digit recognition system

What georeferencing

There is a great deal of geographic data available in formats that can not be immediately integrated with other GIS data. In order to use these types of data in GIS it is necessary to align it with existing geographically referenced data, this process is also called georeferencing. Georeferencing is also a necessary step in the digitizing process. Digitizing in GIS is the process of "tracing", in a geographically correct way, information from images/maps. The process of georeferencing relies on the coordination of points on the scanned image (data to be georeferenced) with points on a geographically referenced data (data to which the image will be georeferenced). By "linking" points on the image with those same locations in the geographically referenced data you will create a polynomial transformation that converts the location of the entire image to the correct geographic location. We can call the linked points on each data layer control points (see Fig. 2).

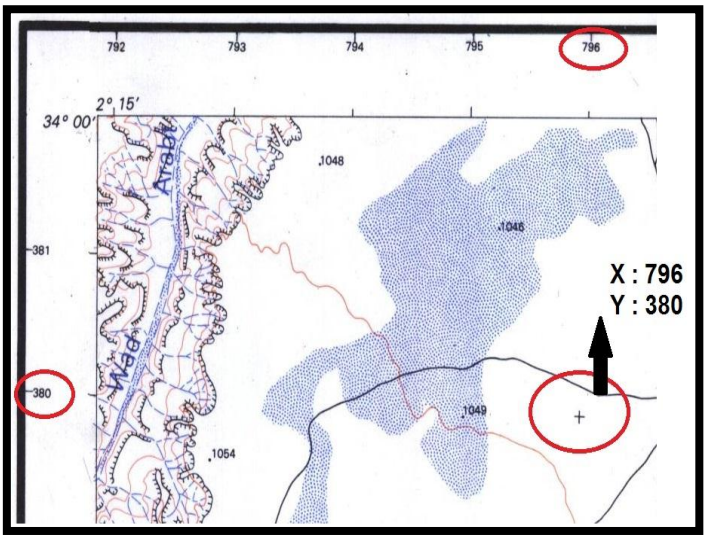

Fig.2: coordinate in the scanned maps with shaped 'tic' marc

Bézier Curves

In Bézier curves are named after their inventor, Dr. Pierre Bézier, an engineer with the Renault car company who set out in the early 1960's to develop a curve formulation for use in shape design that would be intuitive enough for designers and artists to use, without requiring a background in mathematics.
In general if there are n+1 points labeled P_0, P_1, ... P_n, with P_0 and P_n the end points (and all the others control points) then the equation of the Bézier spline between them is:

$$\sum_{i=0}^{n} \binom{i}{n} t^{i} (1-t)^{n-i} P_i$$

If there are two points then this is just the line between the two end points, if three then the quadratic spline used by TrueType, if four then the cubic spline used by PostScript.

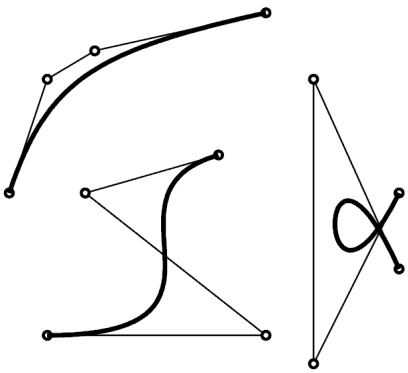

Fig. 3: Examples of cubic Bézier curves.

We can also represent Bézier as matrix operations, by expressing the Bézier formula as a polynomial basis function, the weight matrix, and the actual coordinates as matrix. Let's look at what this means for the cubic curve:

$$B(t)=P_1.(1-t)^3 + 3.P_2.(1-t)^2.t + 3.P_3.(1-t).t^2 + P_4.t^3$$

We can writing the quadratic curve, by matrix, the clever use of matrices, and sometimes the matrix approach can be (drastically) faster.

Approximation of a digit by Bézier curves

To illustrate the method of approaching the shape of a the digit by spline functions, we will treat the case of the the digit 3. As shown in (see Fig. 4),.The continuous splines of degree 3 are obtained by connecting these curves. So, the skeleton of the digit can be seen as a continuous spline (see Fig. 4). The features of the digit are the points and the derivatives which the associated spline is close to the shape of the skeleton. To illustrate this feature extraction method, we treat the case of the digit 3. We partition the shape of this digit into two curves. The first curve starts at Q_1 and arrives at Q_2 and the second starts at Q_2 and arrives at Q_3. After building a spline from dots Q_i and adapted tangents at these dots, we obtain a shape close to that of the digit 2 (see Fig. 4).

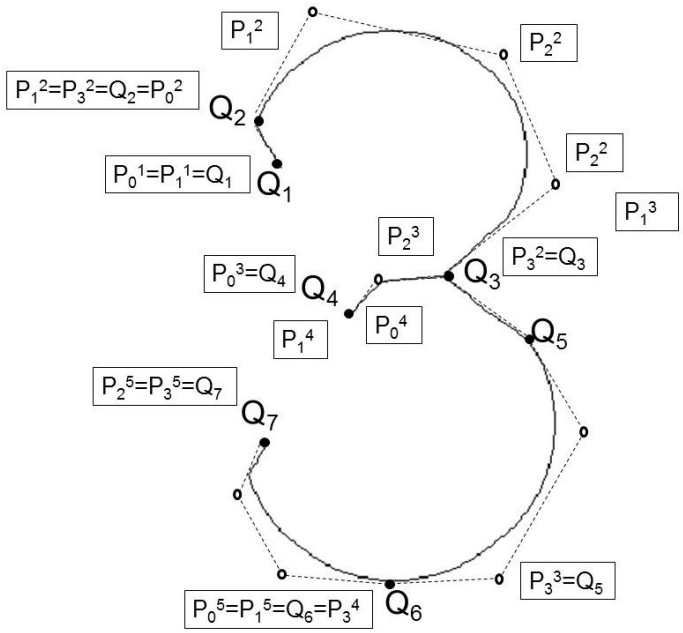

Fig. 4: Bézier data required to reconstruct the digit 3

Are the extremities dots in addition to some dots where the shape of the character presents a variation (changes of direction, inflexion dots and cusps). All these dots with their tangents will represent for us the features which characterize the character[4].

$$M = \begin{pmatrix} Q_1 & Q_2 & \dots & Q_r \\ u_1 & u_2 & \dots & u_r \\ v_1 & v_2 & \dots & v_r \\ e_1 & e_2 & \dots & e_r \end{pmatrix}$$

So, the features of the character *C* with a font f are:

(1) the obtained characteristic dots $(Q_i)1\le i\le r$ $(r \le m)$,

(2) the associated derivatives $(u_i; v_i)1\le i\le r$ $((u_i ; v_i)$ are the two derivative directions of the dot Q_i),

(3) the associated information $(e_i)1\le i\le r$ identifying the characteristic points that belong to loops (e_i = 1 if Q_i belongs to a loop and e_i = 0 otherwise),

(4) the class affiliation *c*,

($c \in LC_0$; LC_1; NLC_0; NLC_1; NLC_2; NLC_3).

Classification and recognition

Neural Network is a network of non-linear system that may be characterized according to a particular network topology. Where, this topology is determined by the characteristics of the neurons and the learning methodology. The most popular architecture Of Neural Networks used in Arabic digits recognition takes a network with three layers. These are: Input layer, hidden layer and output layer. The number of nodes in the input layer differs according to the feature vector's dimensionality of the segment image size.

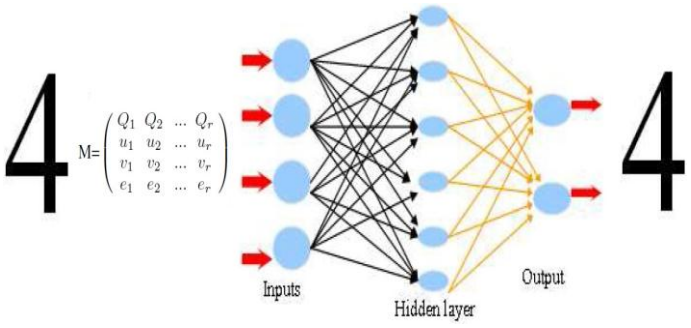

Fig. 5: Scenario of number recognition with artificial neural network

In the hidden layer the number of nodes governs the variance of samples which can be accurately and correctly recognized by this Network. In our system project, the data will be divided using neural networks. In addition, we use the algorithm of back propagation [5].

Results and discussion

We have experimented the network, one with three layers. The network have been trained on the same training data set using feed forward back propagation algorithm. We used different ordering for the data set in the training process. The same test data set has been used for testing network. In Table, we show the results and a comparison. We observe that the network converged more rapidly. The accuracy of recognition is 98.87%.

Tab 1: Recognition accuracy for each digit individually

Num of Num of Accuracy Accuracy Average	
Digits	accuracy (%)
0	100.00
1	98.60
2	98.30
3	95.99
4	98.00
5	99.89
6	98.68
7	99.30
8	100.00
9	99.95
Total	98.87

Conclusion

We can conclude that we reached the computer to the human's brain by the importance use of coordinate in the scanned maps for automated recognition for different applications. This recognition starts with acquiring the image to be preprocessed throw a number of steps. As an important point, classification and recognition have to be done to gain a numeral text.

In a final conclusion, the Bézier curves with neural network seems to be better than other techniques used for recognition.

References and notes

1. C Bernier, H Philippot, E P. Marina, *Reconnaissance de chiffres par carte de Kohonen* Projet.
2. E. M Tzanakou. *CRC Press LLC*, Classifiers: *An Overview, from Supervised and Unsupervised Pattern Recognition: Feature Extraction and Computational Intelligence*. **2000**, 371.
3. W Chung, E Micheli-Tzanakou. *CRC Press, USA*. Classifiers: *An overview, from Supervised and Unsupervised Pattern Recognition: Feature Extraction and Computational Intelligence*. *Illustrated*, **2000**, 371.
4. M. S Khorsheed. Patt Anal, *Off-line Arabic character recognition*,., **2002**, 5, 31-45.
5. A. K. E Miad, A Mazzroui, *Handwritten Arabic Digits Recognition Using Bézier Curves. International Journal of Computer Science Issues (IJCSI);* **2013**, 10 ,5, 257
6. P. J Grother, G.T Candela. *Comparison of handprinted digit classifiers. Technical Report NISTIR 5209, NIST* , **1993.**