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MICROCOMPUTER APPLICATIONS IN SCENE MATCHING

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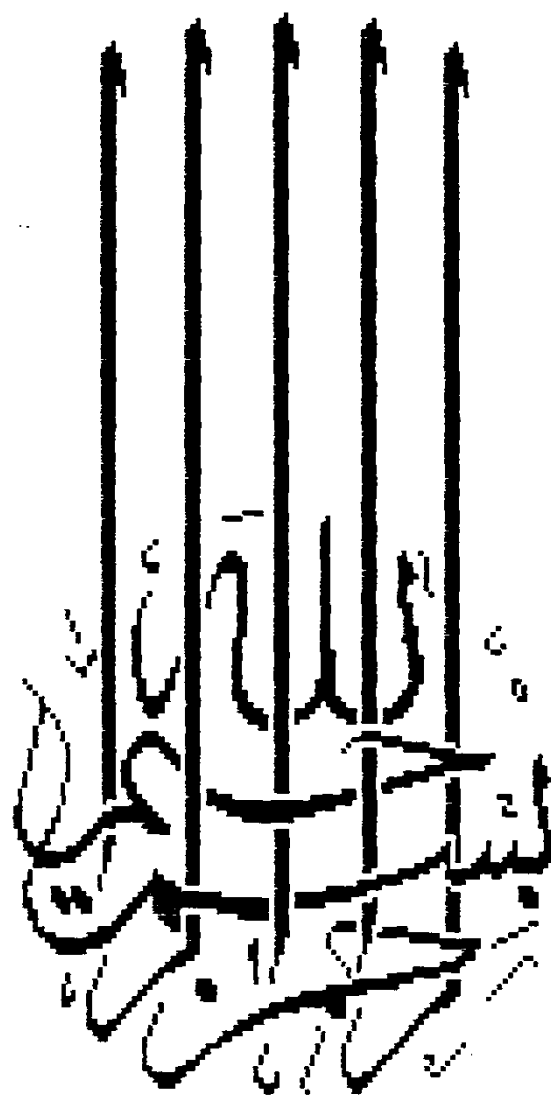
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Statement

This dissertation is submitted to Ain Shams University for the degree of M.Sc. in Electrical Engineering.

The work included in this thesis was carried out by the author in the department of Electronics and Computer Engineering, Ain Shams University, from October 1985 to December 1988.

No part of this thesis has been submitted for a degree or a qualification at any other University or Institution.

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ABSTRACT

This thesis deals with the problem of scene matching. Given a pictorial description of a region of a scene, it is desired to determine which region in another image is similar. The simplest method to solve this problem, which is called template matching, is described as it is the backbone of all other methods.

A review of other image matching techniques using image processing based algorithms such as ordered search techniques in template matching, two-stage template matching, coarse-fine template matching, and sequential similarity detection algorithms are discussed.

The most efficient algorithms for scene matching are analyzed and discussed. Those are the sequential hierarchical scene matching algorithms. The main target of this thesis is to investigate those approaches. The first approach is the basic sequential hierarchical scene matching dealing with gray-scale images. The sequential decision rules are discussed as well as the derivation of threshold sequence. The "pairing functions" concept applied to the second approach, namely, the sequential scene matching using edge features, is described as well as edge extractions and similarity measure.

Experimental results are presented for matching satellite images of Al-Minea (Egypt) and Montana (USA) using those sequential hierarchical scene matching algorithms as well as the two-stage template matching algorithm. The experimental work is done using the Remote Image Processing System (RIPS). The results prove efficiency and success in reaching the best match location with minimum required computations. A comment on the results is presented.

LIST OF SYMBOLS

Chapter 1 :

N	Number of features to be measured for each input pattern
A_X	Feature space
x_K	K th feature measurements
w_j	Pattern class j
$D_i(x)$	Discriminant function
$\sim$	Related to
$r(w_i, d)$	Conditional loss for $X \sim w_i$
$R(P, d)$	Average loss
$r_x(P, d)$	The a posteriori conditional average loss of decision d for a given feature measurement X
d^*	Optimal decision
$L(w_i, d)$	Loss function
λ	Likelihood ratio
e_{ij}	The probability of deciding $X \sim w_i$ when $X \sim w_j$ is true
$U_n(X/w_i)$	The generalized sequential probability ratio test for the i th pattern class

Chapter 2 :

$R(u, v)$	Normalized correlation measure at the reference location (u, v)
$E(u, v)$	Accumulated error at the reference location (u, v)
$m, \bar{n}$	Subtemplate size
t_i	The level value of the i th point of the template
p_i	The level value of the i th point of the picture of the same size

U	The set of template points which are 1
Z	The set of template points which are 0
$N_U(0)$	The number of picture points in U which are 0
$N_Z(1)$	The number of picture points in Z which are 1
n	Number of template points
$N[\mu, \sigma]$	Normal distribution of mean μ and standard deviation σ
$\Phi(u)$	Normal distribution function
$\phi(u)$	Normal density function
r_i	The frequency of occurrence of the gray level value of the i th point in the template
t	Threshold for mismatch measure
$E(p,q,t,m,n)$	Expected computational cost
$I(i,j)$	Sequential Similarity Detection Algorithm surface
W	Window
S	Search area
S_{ij}^M	Subimage of the search area of size $M \times M$

Chapter 3:

L	Number of levels
K	Resolution level K
E_R	Spectral energy
ϵ_A	Aliasing error
$f_K(x,y)$	Gray scale image at resolution level K
$F_K(w_x, w_y)$	Fourier spectrum of the sampled image field $f_K(x,y)$
$s(x,y)$	sampling signal
$\bar{s}$	mean intensity of the image elements

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$\bar{w}$	mean intensity of the window elements
$G_K(i,j)$	Location matrix formed at resolution level K to deal with the image at resolution level K-1
E	Cumulative error
$\bar{E}$	Expected error
T_n^K	Threshold value for resolution level K
SR	Search region
$R(u,v)$	Similarity measure (correlation)
R_b	Correlation with a background level
R_T	Threshold for similarity measures
P_K	Probability of match
P_d	Overall Probability of match
η	Amount of computational saving

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INTRODUCTION