Application of Dynamic Image Processing Techniques and Genetic Algorithms in Vehicles Number Identification.

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Abstract - ***In this research, the design of a new genetic algorithm (GA) is introduced to detect the of vehicles number identification (LP) symbols. The dynamic changes of illumination conditions occurred when converting the image into binary. Connected component analysis technique (CCAT) is used to get candidate objects inside the invalid image. A scale-invariant geometric relationship matrix is introduced to model the layout of symbols in any LP that simplifies system adaptability when applied in different countries. Maximum, two new crossover operators, based on sorting, are introduced, which greatly improve the convergence speed of the system. Color (RGB) to grayscale (GS)conversion is performed using the Filtering technique by eliminating the hue and saturation information while retaining the luminance Most of the CCAT problems, which are touching or broken bodies Edge-based techniques were also implemented to detect the plate based on the high density of vertical edges inside it Detecting license text and at the same time distinguishing it from similar patterns based on the geometrical relationship between the symbols constituting the license numbers is the selected approach in this research. In these plates usually contain different colors, which are written in different languages, and use different fonts .some plates may have a single color background and others have background images.***

Key Words: *Genetic algorithms, image processing, image representations, license plate detection, machine vision, road vehicle identification, sorting crossover*

1. Introduction

The detection stage of the LP is the most critical step in an automatic vehicle Number identification system [1]. A numerous research has been carried out to overcome many problems faced in this area but there is no general method that can be used for detecting license plates in different places, states, counters. Because of the difference in plate style or design.

Detecting license text and at the same time distinguishing it from similar patterns based on the geometrical relationship between the symbols constituting the license numbers is the selected approach in this research. Consequently, a new technology is introduced in this paper which detects LP symbols without using any information associated with the plate's outer shape or internal colors to allow for the detection of the license numbers in case of shape or color distortion either physically or due to capturing conditions such as low lighting, shadows and camera position and orientation. Objects and to allow for tolerance in the general process, a new genetic algorithm has been designed with a new flexible fitness function. Image processing is done at first in GA phase.

All the developed techniques can be categorized according to the selected features upon which the detection algorithm was based and the type of the detection algorithm itself. Color-Based systems is built to detect specific plates having fixed colors [2] , [3] , [4] . External-shape based techniques were developed to detect the plate based on its rectangular shape [5], and [6].

A complete overview of the system is given in Section 2 using fig.1. Image processing stages are presented in Section 2.1. In Section IV, GA formulation is demonstrated. In Section 6, modifications to the GA stage to overcome most of the problems associated with CCAT are summarized.

1.1 PROBLEM STATEMENT

In this Proposed System, the design of a new genetic algorithm (GA) is introduced to detect the locations of license plate (LP) symbols. A new technique is introduced in this paper that detects LP symbols without using any information associated with the plate's outer shape or internal colors. The proposed system is composed of two phases: image processing phase and GA phase.

Motivation: Distorted plate images are successfully detected due to the independency on the shape, color, or location of the plate. Detect different places and countries.

Detecting license text and at the same time distinguishing it from similar patterns

1.2 EXISTING SYSTEM

Bernstein algorithm combined with the Gaussian filter was used as the existing algorithm, for shadow removal method. The Existing algorithm is concerned with the license plates of one specific country. An algorithm for license plate recognition (LPR) applied to the intelligent transportation system is proposed on the basis of a novel shadow removal technique and character recognition algorithms. The Existing License plate extraction based on vertical edge detection and mathematical morphology.

1.3 PROPOSED SYSTEM

In this Proposed System, the design of a new genetic algorithm (GA) is introduced to detect the locations of license plate (LP) symbols. A new technique is introduced in this paper that detects LP symbols without using any information associated with the plate's outer shape or internal colors. The proposed system is composed of two phases: image processing phase and GA phase. A new genetic-based prototype system for localizing 2-D compound objects inside plane images was introduced and tested in the localization of LP symbols. In Proposed System, we can implement the Car License plate through image.

A. User Module

1. Setup Model

- The user can register and login with the owner permission for use an application.
- The owner provides session key based on the requirements of the trusted user.

2. Trusted User and node creation Module

- In this module, the trusted user gets login by admin permission.
- The data is shared between two trusted users by session key generation for their respective data's and encrypting their files.

3. Device module

- Using Capture device an image in input to system to recognized number plate.
- Device can CCTV, camera, Digital camera, etc…

B. Administrator Module

I. Image Processing Module

- The different image processing stages that finally produce image objects to the GA phase
- An input color image is converted to a sequence of processes to extract the relevant two dimensional objects that may represent the symbols constituting the LP.
- This module that are carried out in different stages.

II. Image conversion

- A difference conversion is done on images to apply an algorithm for required result.
- Conversion is done using different techniques.

III. Convergence module

- In this module various convergences is measured for best case and average cases.
- An average distance can be carried out as an reliable.
- Images generated at various camera-to-object relative positions in different lighting conditions.

2. SYSTEM DEVELOPMENT

The proposed system is composed of two phases: image processing phase and GA phase. Each phase has many different stages.
The flowchart in Fig. 1 depicts the various image processing stages that finally produce image objects to the GA phase.

The fig 1 is as shown below.

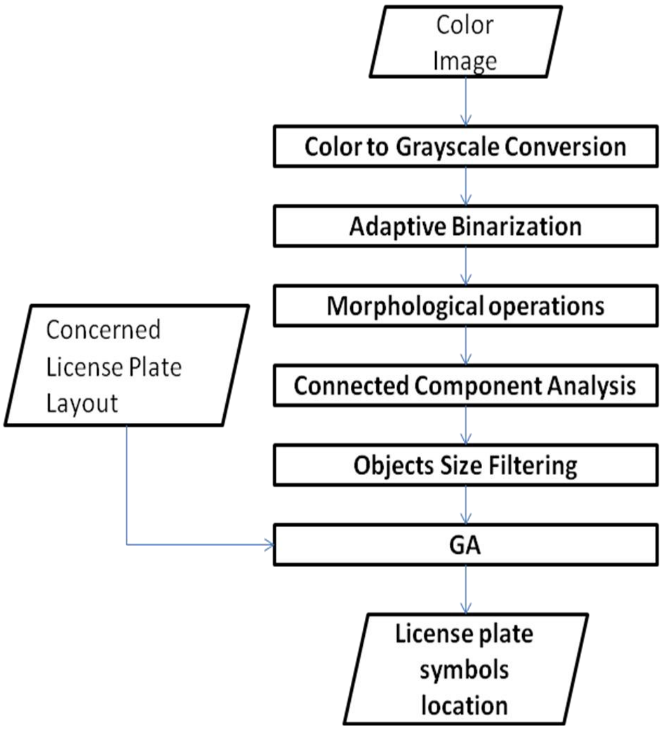


Fig -1: Overall Structure of System Development.

2.1 IMAGE PROCESSING PHASE

In this phase, an input color image is converted to a sequence of processes to extract the relevant two dimensional objects that may represent the symbols constituting the LP.
These processes that are in different stages, as depicted in Fig. 1, will be shown as above.

STEP 1:- Color to grayscale conversion.

The input image is captured as a color image taking into account further processing of the image to extract other information relevant to the concerned vehicle. Color (RGB) to grayscale (gs) conversion is performed using the standard NTSC method by eliminating the hue and saturation information while retaining the luminance as follows:

$$gs=0.299*R+0.587*G+0.114*B$$

STEP 2:- Gray to binary using a dynamic adaptive threshold.

Converting the input image into a binary image is one of the most sensitive stages in localizing LPs due to spatial and temporal variations encountered in the plate itself and the environment around it resulting in several problems. Hence binarization of the image according to a fixed global threshold is not suitable to overcome these problems.

If the pixel intensity is higher than 90% of the local mean it is assigned to the background; otherwise it is assigned to the foreground. The 10% offset below the mean is chosen experimentally to minimize the sensitivity to fluctuations in illumination.

A 30 x 30 window has been applied on the first set of image samples used in this research, which resulted in a high accuracy rate in different illumination conditions as will be presented in the results section.

STEP 3:- Morphological operations

This operations such as dilation and erosion are important processes needed for most pattern recognition systems to eliminate noisy objects and retain only objects expected to represent the targeted patterns.

In LP detection, closing operation (dilation followed by erosion) is performed to fill noisy holes inside candidate objects and to connect broken symbols.

On the other hand, opening (erosion followed by dilation) is applied to remove objects that are thinner than the LP symbols.

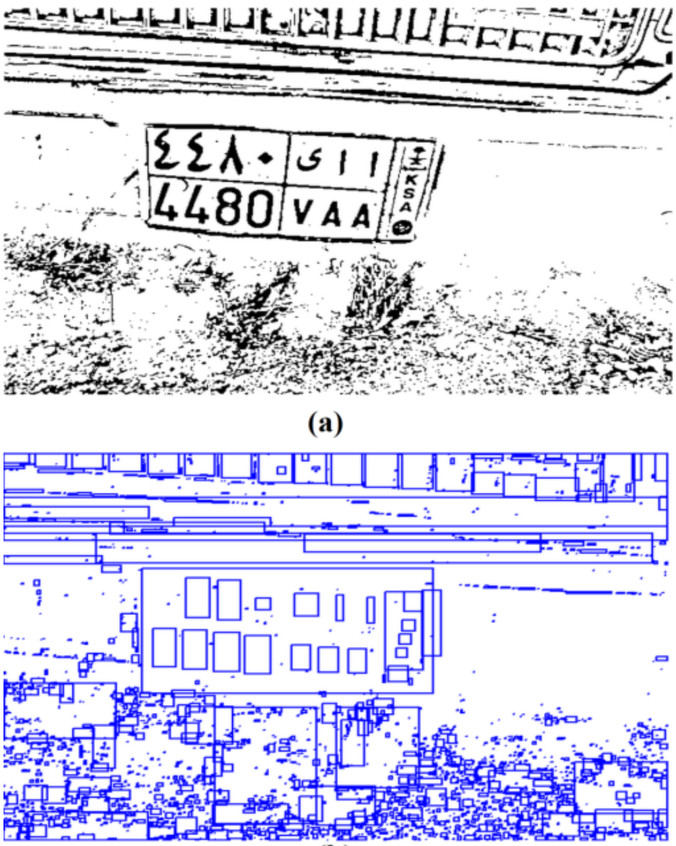
STEP 4:- Connected Component Analysis (CCA) and objects extraction

CCA is a well known technique in image processing that scans an image and groups pixels in labeled components based on pixel connectivity [7]. An 8-point CCA stage is performed to locate all the objects inside the binary image Produced from the previous stage. The result of this stage is an array of N objects.

Fig 2 shows an both input and output of an Connected Component Analysis (CCA). Fig 2 is shown below..

In the fig 2, an A image is of in Input image of an number plate and B is an output of input A.

Result an B image occurred.



(a)

(b)

Fig-2: Input and Output of CCA

STEP 5:- Size filtering

The objects taken from the CCA stage are filtered on the basis of their widths Wobj and heights Hobj such that the dimensions of the LP symbols lie between their respective thresholds as follows:

$Wmin \leq Wobj \leq Wmax$ *and* $Hmin \leq Hobj \leq Hmax$

2.2 GA PHASE

In this section, the formulation of the GA phase to resolve the 2D compound object detection problem will be introduced in details, indicating the encoding method, initial population setup, fitness function formulation, selection method, mutation and crossover operator design and parameters setting.

A. Chromosome encoding

Encoding of a compound object such as the LP is accomplished based on the constituting objects inside it. The next step after plate detection is to recognize the license number; there for the main symbols identifying the plate number should be included as a minimum.

An integer encoding scheme has been selected where each gene i is assigned an integer j which represents the index to one of the M objects output from the size filtering stage. The information that will used for each object j is as follows

- The upper left corner coordinates (X, Y) of the rectangle bounding the object.
- The height (H) and width (W) of the rectangle bounding the object.

B. Defining the fitness function

The proposed fitness is selected as the inverse of the calculated objective distance between the prototype chromosome and the current chromosome. Firstly we will show,
How can the geometric relationships between the objects inside a compound object are represented followed by a discussion of parameter adaption in case of various LP detection layouts.

Compound object representation

Suppose If two objects are present, we will use two types of geometrical relationships that can be defined as follows:

1. Position relationship:

The position relationship can represent by the relative distances between the bounding boxes of the two objects in the X and Y directions.

2. Size relationship:

The size relationship can represented as the relative differences in their bounding boxes' heights and widths.

C. The selection method

In our system, the Stochastic Universal Sampling (SUS) method has been adopted for the selection of offspring in the new generation. In SUS method [8], each individual is mapped to a continuous segment of a line equal in size to its fitness as in roulette-wheel selection. There for, a number of equally spaced pointers are placed over the line depending on the percentage of individuals to be selected. In this system, individuals of ninety percent of the population size (0.9 Z) are selected to be exposed to mutation and crossover operators.

D. Mutation operators

Mutation is needed because successive removal of less fit members in genetic iterations may eliminate some aspects of genetic material forever.

E. Crossover operator

There are many methods to implement the crossover operator. That are, Single point crossover, two point crossover, n-point crossover, uniform crossover, three parent crossover and, alternating crossover [9], etc. These operators are not suitable for our problem because the resultant children will not be valid because of repeated genes that may be produced in the generated chromosomes.

F. Replacement strategy

Many replacement strategies are used in case of replacing only a portion of the population between generations. The most common and generally strategy is to probabilistically replace the less fit individuals in the previous generation. In this strategy the best fit individuals of the previous generation are appended to the current population [10]. In our proposed system, the best 10% of the parents are selected and appended to the offspring (90%) to produce the new generation (100%).

G. Stopping criteria

1-The best chromosome's objective distance (OD) is max to 5. (This value is found by trial and error).

2-The average objective distance (AOD) is not improved for 6 successive generations. In such case, the chromosome having minimum objective distance can be accepted if it is Max to 8.

3- The number of generations Ngen comes to the maximum number of generations MaxNgen (set to 20).

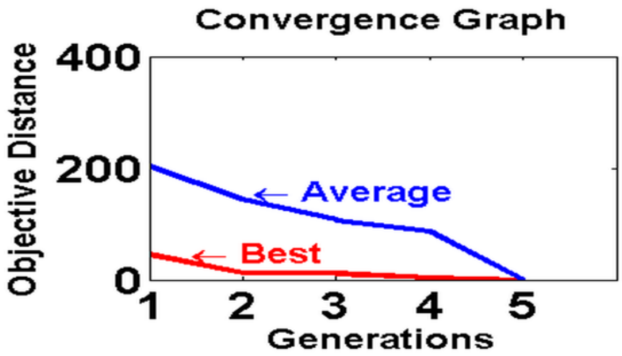
H. *Parameters setting*

The population size (Z) is selected dynamically according to the formula developed in [10] as follows:

Z =1.65 × 2(0.21*blength)

Where blength is the length of the chromosome in case of binary encoding. In the case of integer encoding, for M genes and L objects, we substitute for blength by:

blength =L (Log2(M))



Graph 1:- Convergence Graph

This graph shows in best case and average case of an image processing. It is use to get reliability of an application. It shows a max distance covered by an application. Camera quality also depends in this process.

3. MINIMIZING CCAT PROBLEMS

The main drawback of all systems relying on CCAT is the sensitivity to negative or positive noise that may cause some symbols to be connected to other objects or broken into smaller objects. Connectivity is can also been affected by many causes such as bullets, aging, dirt, , occlusion, shadows, or due to image processing operations like dilation and erosion.

OVER COME TO THIS PROBLEMS

The solution for this problem is to generate the new argument in the genetic algorithm which indicates the number of symbols to skip (NS) during the evaluation of the objective distance. This number is initialized to zero in the first run of the GA and according to the optimum OD threshold value (ODT), The decision is made either to accept selected chromosome or to increase the NS argument and execute a further run of the GA. Depending on the number of LP symbols (L) under consideration, the skipping number NS can come across to a maximum value given that L-NS>=3. If the NS is greater than zero then NS random numbers having values between 1 and L are generated inside the OD evaluation function, and the gene error distances are skipped.
Finally if the OD threshold (ODT) test is met, the location and the size of skipped symbols are estimated based on the GRM matrix and the non skipped symbols using some geometrical rules. The flow chart shows the logic of these steps is shown in Fig. 16. The proposed modification has been easily solved many problems happening due to static causes like dirt and pullets or dynamic causes like shadows, lighting and even fast shake by camera movement because it gives another dimension for solving

the LP detection problem by expecting locations of occluded or distorted symbols. An example of two images from two different layouts (Saudi and Greece) containing touching symbols in two different ways which have been correctly detected after GA modification.

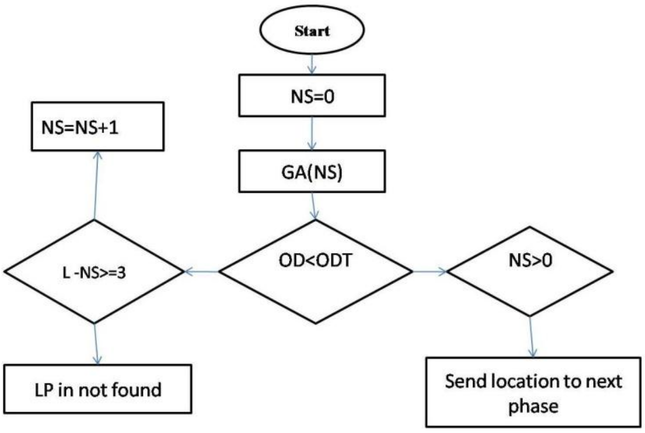


Fig-3: Flowchart for detecting LP's symbols in case of touching and broken symbols.

Considering the genetic phase's speed is great enhancement has been achieved after using the USPS crossover operator. Some Research may consider clustering objects according to their sizes and/or positions before being supplied to the genetic phase to allow for the detection of multiple plates and at the same time to increase the system speed. Currently, system can be used as it is in parking management systems, and also in the detection of LPs in pictures taken in emergent circumstances that do not allow adjustment position and orientation of the camera with respect to the vehicle. An important point that should be recorded here is that through all the experiments done, we had been tried many types of local adaptive thresholding methods, no one of them gave 0% error rate but after introducing the skipping part of the genetic phase the error percentage due to binarization has been minimized as shown in the final results. Dynamic thresholding has been used a lot but integrating it with CCAT and the skipping GA gives our technique distinction among others. In this world various computation time of the system is increase, the skipping part in the genetic phase reduces human intervention rate in case of system failure in the detection of some LPs. we can also say that, more effort should be carried out in the image processing phase to reduce the skipping time while maintaining high accuracy rate of the system.

4. CONCLUSIONS

In this paper describes the vehicle number license plate detection in a efficient manner. For this purpose we used genetic algorithm (GA). The license plate which many contain unwanted details. These may firstly remove by the image processing phase and then localized by the genetic algorithm phase. The results were easily encouraging and a new approach for solving the LP detection problem relying only on the geometrical layout of the LP symbols. Also, a flexible system was introduced that can be simply adapted for any LP layout by constructing its GRM matrix. This system possessed high immunity to changes in illumination either temporarily or spatially. A high percentage success rate was achieved with the aid of the adaptability aspect of the GAs. A very important attainment or problems is overcoming most of the problems arising in techniques based on CCAT by allowing the GA. Also, an enhancement in the performance of the developed GA was achieved by applying the new USPS crossover operators, which vary greatly improved the convergence rate of the whole system.

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