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Principle of Automatic Number Plate Recognition

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Abstract: **Automatic recognition of car license plate number became very important in our daily life because of the unlimited increase of cars and transportation systems which make it impossible to be fully managed and monitored by humans, examples are so many like traffic monitoring, tracking stolen cars, managing parking toll, red-light violation enforcement, border and customs checkpoints. Yet it's a very challenging problem, due to the diversity of plate formats, different scales, rotations and non-uniform illumination conditions during image acquisition. This paper mainly introduces an Automatic Number Plate Recognition System (ANPR) using Morphological operations, Histogram manipulation and Edge detection Techniques for plate localization and characters segmentation.**

Keywords: **Artificial Neural Networks, Edge Detection, Character segmentation, Contours, Image Processing Region of interest (ROI).**

1. INTRODUCTION

Automatic number plate recognition (ANPR) is a mass surveillance method that uses optical character recognition on images to read the license plates on vehicles.

Loumos V & Kayafas E (2013), License plate recognition Algorithms for Intelligent Transportation System Application. They can use existing closed-circuit television or road-rule enforcement cameras, or one specifically designed for the task. They are used by various police forces and as a method of electronic toll collection on pay-per-use roads and monitoring traffic activity, such as red light adherence in an intersection.

ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configured to store a photograph of the driver.

Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. A powerful flash is included in at least one version of the intersection monitoring cameras, serving both to illuminate the picture and to make the offender aware of his or her mistake. ANPR technology tends to be region-specific, owing to plate variation from place to place.

The objective of the paper is to successfully locate standard Nigeria number plate, segment characters and recognize them given a car image. The system must deal with different angles, distances, scales, resolutions and illumination conditions.

ANPR was invented in 1976 at the police Scientific Development Branch in UK. Prototype system were working by 1979, and contracts were awarded to produce industrial systems, first at EMI Electronics, and then at Computer recognition systems (CRS) in Workingham, UK. Early trial systems were deployed on the A1 road that is major road and at the Darford Tunnel. The arrest through detection of a stolen car was made in 1981.

However, ANPR did not become widely used until new developments in cheaper and easier to use software were pioneered during the 1990s. The collection of ANPR data for future use that is in solving unidentified crimes was documented in the early 2000s.

The first documented case of ANPR being used to help solve a murder occurred in November 2005, in Bradford, UK where ANPR played a vital role in locating and subsequently convicting killers of Sharon Beshenivsky.

The objective of this seminar is to successfully locate standard Nigeria number plate, segment characters and recognize them given a car image. The system must deal with different angles, distance, scale, resolutions and illumination conditions is a technology that uses optical character recognition on images to read vehicle registration plates. It can use existing closed-circuit television, road-rule enforcement cameras, or cameras specifically designed for the task.

In some countries, ANPR systems installed on country borders automatically detect and monitor border crossings. Each vehicle can be registered in a central database and compared to a black list of stolen vehicles. In traffic control, vehicles can be directed to different lanes for a better congestion control in busy urban communications during the rush hours.

Problem Statement:

The main focus in this research project is to experiment deeply with, and find alternative solutions to the image segmentation and character recognition problems within the License Plate Recognition framework. Three main stages are identified in such applications.

First, it is necessary to locate and extract the license plate region from a larger scene image. Second, having a license plate region to work with, the alphanumeric characters in the plate need to be extracted from the background. Third, deliver them to an OCR system for recognition. In order to identify a vehicle by reading its license plate successfully, it is obviously necessary to locate the plate in the scene image provided by some acquisition system (e.g. video or still camera).

Locating the region of interest helps in dramatically reducing both the computational expense and algorithm complexity. For example, a currently common 1024x768 resolution image contains a total of 786,432 pixels, while the region of interest (in this case a license plate) may account for only 10% of the image area. Also, the input to the following segmentation and recognition stages is simplified, resulting in easier algorithm design and shorter computation times.

The paper mainly work with the standard Egyptian license plates but the techniques, algorithms and parameters that is be used can be adjusted easily for any similar number plates even with other alpha-numeric set.

Significance of automatic number plate:

i. Border crossing

ii. Automobile repossession

iii. Section control, to measure average vehicle speed over a long distance

iv. ANPR for the observant of traveller behaviors.

v. To assist visitor management system in recognizing guest vehicle.

2. MATERIALS

The software aspect runs on standard home computer hardware and can be link to other application or data bases. It first uses a series of image manipulation technique to detect, normalized and enhances the image of the number plate, and then optical character recognition (OCR) to extract the alphanumeric of the license plate.

2.1. Optical Character Recognition (OCR):

John E, Delbert F. and Herrington C. (2010), the function and design of motor vehicle license plate. Is the mechanical or electronic conversion of images of typed hand written or printed text into machine encoded text.

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2.2. Infrared:

Byrnes James (2009), unexploded ordinance detection and mitigation springier. Is electromagnetic radiation (EMR) with longer wave length than those of vehicle light and it is therefore invisible, its visibility is at 700nanomaters frequency at 430THz to 100,0000nm (300GHz).

2.3. Development Process:

It is generally develop in two basic approaches

- It allows for the entire process to be performed at the lane location in real time. E.g. Detecting a snap short, normalizing the snap short and then enhancing the image of the number plate as it takes place.
- It transmits all the images form many lanes to a remote computer location and performs the OCR process there at some later point in time.

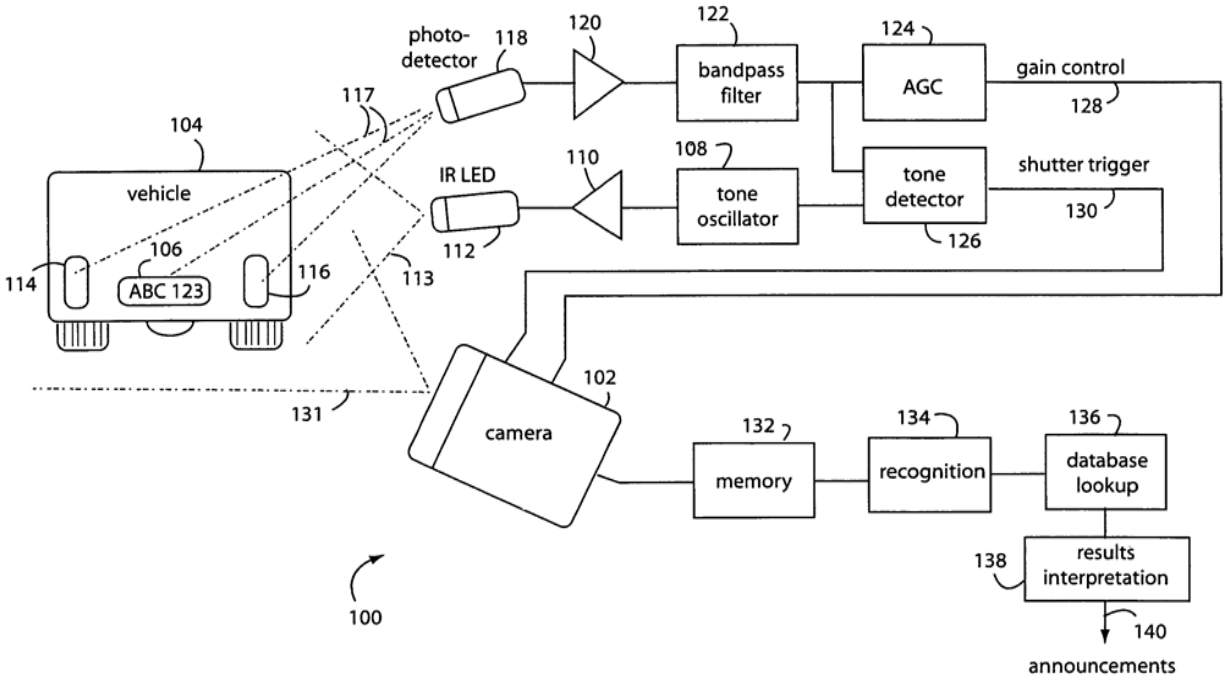

Fig 1: Development Process

3. TECHNOLOGY

The automatic number plate recognition ANPR uses optical character recognition (OCR) on image taken by camera. The camera used can be existing road rule enforcement or close circuit television (CCTV) as well as mobile units which are usually attached to vehicles, some use infrared camera to take clearer images of the plate.

Kwas'nicka and Halina (2011), license Plate localization and Registration in camera picture. Gliwice Poland. A software was manufactured that ran on cheaper personal computer (PC) based, non-specialist hardware that also no longer needed to be given pre-defined angles, directions, size and speed in which will be passing in camera field of view.

Methodology:

There Are Seven (7) Primary Algorithms that the Software Requires For Identifying License Plate.

- ***Plate localization:*** This is responsible for finding and isolating the plate on the picture
- ***Plate Orientation and Sizing:*** Compensate for the skew of the plate and adjust the dimension to the require size.
- ***Normalization:*** This adjust the brightness and contrast of the image

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- Optical character recognition
- ***Syntactical/Geometrical Analysis:*** Check characters and positions against country rules.
- ***Character segmentation:*** Finds the individual characters on the plate.
- The averaging of the recognized value over multiple field/ images to produce a more reliable or confident result. Especially since any single image may contain a reflected light flare, be partially obscured or other temporary effect.

The complexity of each of these sub-sections of the programs determines the accuracy of the systems. During the third phase (normalization) some system use edge detection techniques ton increase the picture different between the letters and the plate backing. A median filter may also be used to reduce visual noise on the image.

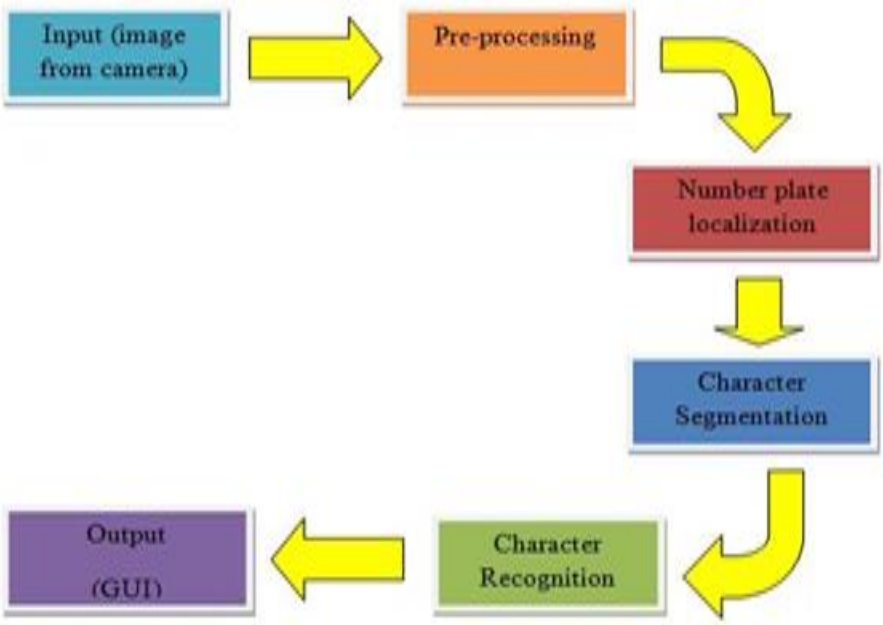

Fig. 2: Algorithms for Segmentation

Principle of plate Segmentation:

Acosta B.D (2013), Experiment in image segmentation for automatic license plate recognition. The segmentation is one of the most important processes in the automatic number plate recognition, because all further steps rely on it. If the segmentation fails, a character can be improperly divided into two pieces, or two characters can be improperly merged together.

We can use a horizontal projection of a number plate for the segmentation, or one of the more sophisticated methods, such as segmentation using the neural networks. If we assume only one-row plates, the segmentation is a process of finding horizontal boundaries between characters.

The second phase of the segmentation is an enhancement of segments. The segment of a plate contains besides the character also undesirable elements such as dots and stretches as well as redundant space on the sides of character. There is a need to eliminate these elements and extract only the character.

4. CHALLENGES

i. Challenges related with mobile ANPR are that the processor and the camera must work fast enough to accommodate relative speed of more 100MPH (160km/hr).

ii. This equipment must be very efficient since the power source is the vehicle and the equipment must be small to minimize the space it required.

iii. Relative speed is one of the issues that affect the camera ability to actually read a license plate. Hence the production of algorithms.

iv. Poor file resolution, usually because the plate is too far away but some time resulting from the use of a low quality camera.

v. Blurry images particularly motor blur.

vi. Poor lighting and low contrast due to over exposure, reflection or shadows.

vii. An object obscuring (part of) the plate, quite often a low bar, or dirt on the plate.

viii. Read license plate that are different at the front and the back because of the towed trailers campers.

ix. Vehicle lane change in the camera angles of view during license plate reading.

x. Circumvention techniques.

5. CONCLUSION

The objective of this paper was to study and resolve algorithmic and mathematical aspects of the automatic number plate recognition systems, such as problematic of machine vision, pattern recognition, OCR and neural networks. The problematic has been divided into several chapters, according to a logical sequence of the individual recognition steps. Even though there is a strong succession of algorithms applied during the recognition process, chapters can be studied independently.

ANPR solution has been tested on static snapshots of vehicles, which has been divided into several sets according to difficultness. Sets of blurry and skewed snap- shots give worse recognition rates than a set of snapshots which has been captured clearly. The objective of the tests was not to find a one hundred percent recognizable set of snapshots, but to test the invariance of the algorithms on random snapshots systematically classified to the sets according to their properties.

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