AUTOMATIC GATE KEEPING SYSTEM BASED ON LICENCE PLATE DETECTION USING MATLAB

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ABSTRACT

Intelligent Automatic Gate keeping System(IAGS) is a kind of an intelligent transport system. The purpose of this work was to develop a real time application which recognizes license plates from cars at a gate, for example at the entrance of a parking area or a border crossing. The system based on regular PC with a camera catches frames which include a visible car license plate and processes them. Once a license plate is detected, its digits are recognized, displayed on the database with date and time of the arrival. The focus is on the design of algorithms used for extracting the license plate from a single image, isolating the characters of the plate and identifying the individual characters. The proposed system has been implemented using MATLab.

Keywords : Image processing, IAGS, Segmentation, MATlab.

I INTRODUCTION

It is believed that there are currently more than half a billion cars on the roads worldwide. All those vehicles have their vehicle identification number as their primary identifier. The vehicle identification number is actually a license number which states a legal license to participate in the public traffic[1].

Massive integration of information technologies into all aspects of modern life caused demand for processing vehicles as conceptual resources in information systems. Because a standalone information system without any data has no sense, there was also a need to transform information about vehicles between the reality and information systems. This can be achieved by a human agent, or by special intelligent equipment which is be able to recognize vehicles by their number plates in a real environment and reflect it into conceptual resources. Because of this, various recognition techniques have been developed and number plate recognition systems are today used in various traffic and security applications, such as parking, access and border control, or tracking of stolen cars.

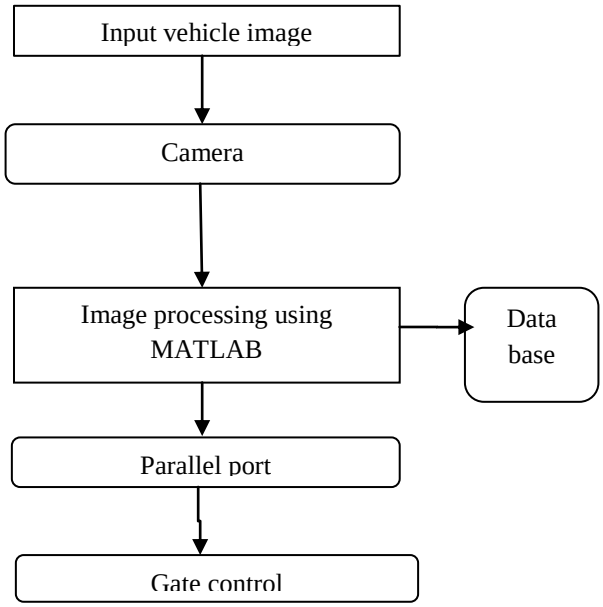
In entrance gate, number plates are used to identify the vehicles. When a vehicle enters an input gate, number plate is automatically recognized and stored in database and black-listed number is not given permission. When a vehicle later exits the place through the gate, number plate is recognized again and paired with the first-one stored in the database and it is taken a count. Automatic number plate recognition systems can be used in access control. For example, this technology is used in many companies to grant access only to vehicles of authorized personnel[2].

II.METHODOLOGY

Automatic number plate recognition system is a special set of hardware and software components that precedes an input graphical signal like static pictures or video sequences, and recognizes license plate characters from it. A hardware part of the IAGS system typically consists of a camera, image processor, camera trigger, communication and storage unit. The hardware trigger physically controls a sensor directly installed in a lane. Whenever the sensor detects a vehicle in a proper distance of camera, it activates a recognition mechanism. Alternative to this solution is a software detection of an incoming vehicle, or continual processing of the sampled video signal. Software detection, or continual video processing may consume more system resources, but it does not need additional hardware equipment, like the hardware trigger. Image processor recognizes static snapshots captured by the camera, and returns a text representation of the detected license plate. IAGS units can have own dedicated image processors (all-in-one solution), or they can send captured data to a central processing unit for further processing. The image processor is running on special recognition software, which is a key part of whole IAGS system.

Because one of the fields of application is a usage on road lanes, it is necessary to use a special camera with the extremely short shutter. Otherwise, quality of captured snapshots will be degraded by an undesired motion blur effect caused by a movement of the vehicle. For example, usage of the standard camera with shutter of 1/100 sec to capture a vehicle with speedof 80 km/h will cause a motion skew in amount of 0.22 m. This skew means the significant degradation of recognition abilities. There is also a need to ensure system invariance towards the light conditions. Normal camera should not be used for capturing snapshots in darkness or night, because it operates in a visible light spectrum. Automatic number plate recognition systems are often based on cameras operating in an infrared band of the light spectrum. Usage of the infrared camera in combination with an infrared illumination is better to achieve this goal. Under the illumination, plates that are made from reflexive material are much more highlighted than rest of the image. This fact makes detection of license plates much easier[3][4].

III.BLOCK DIAGRAM



3.1 Input vehicle image

Given that most plates are in roughly the same position and format it is feasible to use an automated or manual camera (e.g. hand-held, in a fixed position on a building or bridge) to take a digital image of a selected vehicle or vehicles in a stream of traffic. Selection might be manually determined by an operator or automatic, for example of every vehicle passing a particular point or every heavy vehicle (with size triggering the camera). This can be implemented in the city traffic or in some toll booths, gates, anywhere there is a requirement for identifying a vehicle.

That software, a more powerful form of the tool used in many domestic and business desktop scanners, parses the image in seeking to recognise shapes in the pixels as characters on a number plate. Although there is disagreement about the effectiveness of such recognition, it is common to encounter claims that the accuracy of interpretation is between 95% and 98% (with best results in regimes where equipment is properly maintained and there is little variation in plates, for example few 'vanity' or 'celebration' plates). Some difficulties may be faced due to mismatching of fonts in different number plate. That is, especially in Indian vehicle, many of them are not following the authorised format of number plates. This software is designed for the recognition of number plates, which follows the authorised format for Indian number plate, called 'IND' number plate[6].

Data analysis is automatic but is often independent of the device, i.e. takes place on a server or other machine at a remote location linked to the camera via a high speed line. So the camera can also be placed in a distance from the recognition device, which may be more useful in the high density traffic.

3.2 Camera

Many IAGS systems feature dual cameras: an infra-red device that captures multiple images of the specific number plate and a conventional colour device that records an image of the plate in context, i.e. takes a snap of the car. Because much capture concerns speeding vehicles and may take place in adverse conditions such as rain and smog, multiple images from the infra-red are 'resolved' to provide a 'best fit' image that is not blurred and that can be quickly interrogated. Most of the IAGS system is designed to be operated in day and night operation. The infrared camera can help in this aspect to make possible, the night time image capturing. As a basic version of the system, here we use a conventional colour device, a high resolution webcam.

3.3 Image processing

Image Processing generally involves extraction of useful information from an image. This useful information may be the dimensions of an engineering component, size of diagnosed tumour, or even a 3D view of an unborn baby. The main areas of application of Image Processing are Bio-Medical, Engineering, Quality Control, Face Detection, Traffic Control etc. This provides a comprehensive set of reference-standard algorithms and graphical tools for image processing, analysis, visualization, and algorithm development. You can perform image enhancement, image deblurring, feature detection, noise reduction, image segmentation, spatial transformations, and image registration. Many functions in the toolbox are multithreaded to take advantage of multicore and multiprocessor computers[5].

The fundamental step used in image processing involves many stages: image acquisition, enhancement, restoration, image processing, wavelets, compression, morphological processing, and segmentation[5].

3.4 Parallel port

The Parallel Port is the most commonly used port for interfacing home –made projects. This port will allow the input of up to 9 bits or the output of 12 bits at any one given time, thus requiring minimal external circuitry to implement many simpler tasks. The port is composed of 4 control lines, 5 status lines and 8 data lines. It's found commonly on the back of our PC as a D-Type 25 Pin female connector. There may also be a D-Type 25 pin male connector. This will be a serial RS-232 port and thus, is a totally incompatible port.

3.5 Gate control

Gates may run over a foundation track or a cantilever system. A foundation track will be installed across the width of the driveway and extent the same distance again to the side of the pillars (on the side to which the gate opens). Rollers on the bottom of the gate run over the foundation track – just like a train on rails. A cantilevered gate is used where a track across the drive or entrance is not wanted or is not possible (for example on a sloping or uneven driveway).Gates are operated by a motor and gearbox which are installed in the inside of the gate behind the pillar (so that it is out of view). The motor engages with a toothed track on the back of the gate to provide the traction to move the gate.

3.6 Data base

Database is used to record the data regarding the entering vehicles. It's mainly used to record the number, date and time of entry should be saved and stored in the memory.

IV.SYSTEM HARDWARE

The IAGS hardware mainly consist of the image capturing device, illumination, vehicle presence sensors, gate controlling motor and a PC with MATLAB installed. For the manual operation of the system, sensors are not required. In our project the hardware part is separately designed and its integration will be carried out in the extended version, which requires some more programming for interfacing. Interfacing of sensors and the motor can be done using parallel port of the PC. For this purpose we have to configure the parallel port via programming it.

The following explains shows the proposed hardware setup for the IAGS system.

4.1 Image capturing device (camera)

Image capturing device can be any camera which is connected to computer via USB. Here we use 'Frontech' JIL2222 USB webcam. In the initial stages of programming, we made use of the integrated camera of the laptop. Infra red cameras can give more clear images even in the low illumination atmosphere. Also it can be used in the night mode of operation.

4.2 Illumination

Illumination is used to make the image capturing easy and to produce more clear images from which the characters can be extracted easily. Since the 'IND' number plates have reflective backgrounds, black coloured

characters are projected under illumination. A set of LEDs are used along with the camera for the purpose of providing illumination.

4.3Vehicle presence sensors

Two set of IR sensor modules are used in the system one before the camera, and another after camera. The first one is used for detecting the presence of the vehicle, when comes towards the checking system. When sensor detects the vehicle, the camera activates and captures the image. This image will be processed by the software. After entering details software sends signal to open the gate. Second sensor is used for checking whether the vehicle is passed the gate. When the vehicle is passed this sensor, Opened gate will get closed.

4.4 Gate controlling motor

A stepper motor is attached to the gate, which controls the opening and closing of the gate according to the signal obtained from the software. We cannot connect a motor directly to the software, since the signal is not sufficient to a motor of that much high power. So we have to use some intermediate ICs in between the software and the motor. Here we go for the Darlington pair IC (ULN2003)

4.4.1. Darlington pair ic(uln2003):

Ideally suited for interfacing between low-level logic circuitry and multiple peripheral power loads, the Series ULN20xxA/L high voltage, high-current Darlington arrays feature continuous loadcurrent ratings to 500 mA for each of the seven drivers. At an appropriate duty cycle depending on ambient temperature and number of drivers turned ON

simultaneously, typical power loadstotaling over 230 W (350 mA x 7, 95 V) can be controlled. Typical loads include relays, solenoids, stepping motors, magnetic print hammers, multiplexed LED and incandescent displays, and heaters.

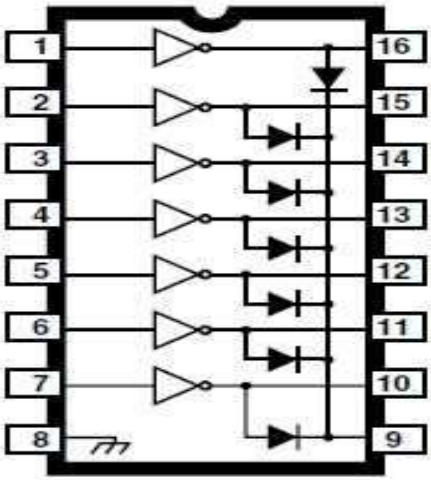


Fig 4.2 Darlington pair ULN2003

4.5 Parallel port

Parallel port is the most easiest and efficient way to communicate computer with external hardware and control devices. Parallel communication requires as much wires as the no. of bits in a word for its transmission. Parallel port is generally a 25 pin female connector with which a printer is usually attached.

The Data, Control and status lines are connected to their corresponding registers inside the computer. So by manipulating these registers in program , one can easily read or write to parallel port with programming languages like 'C' and BASIC.

1. Data register
2. Status registers
3. Control register

Data register is connected to Data lines, Control register is connected to control lines and Status register is connected to Status lines. So whatever you write to these registers, will appear in corresponding lines as voltages, Of course, you can measure it with a multimeter. And whatever you give to Parallel port as voltages can be read from these registers. For example, if we write '1' to Data register, the line Data0 will be driven to +5v. Just like this, we can programmatically turn on and off any of the data lines.

V.SYSTEM SOFTWARE

Different algorithms are used in the system programming in order to get the desired image processing output. These algorithms are implemented in different steps of program. Some of them are made as called functions of the main program. Following are the different system algorithms used in the different stages of operation of the system.

5.1 System algorithm

1. Input image from webcam.
2. Convert image into binary.
3. Detect number plate area.
4. Segmentation.
5. Number identification.
6. Save to file in given format

5.1.1Input Image

1. Capture image from webcam.
2. Store the captured image into a image file for further processing.

5.1.2Convert Image into Binary

1. Identify the intensity of the image.

If image intensity = high Reduce intensity Else if intensity = low Increase intensity Else No change.

2. Convert image into gray scale.
3. Calculate appropriate threshold value for the image
4. Convert the image into binary image using the calculated threshold.

5.1.3Detecting Number plate area

1. Fill small holes including numbers of Number plate so that number plate area will be large to isolate from figure.
2. Determine width and height of the image.

3. Scan each pixel of line counting number of white pixels in the following system,

If number of 'white' pixels < x; pixels become 'black' Else; no change If number of 'white' pixels > y; pixels become 'black' Else; no change the value of x and y may be changed according the image intensity and plate area.

4. Use the step no. 3 for both horizontal and vertical direction.
5. Check number of possible areas
6. Logically AND with binary image obtained at "Convert image into binary algorithm.
7. Crop the required area.

5.1.4Segmentation

1. Filter the noise level present in the image.
2. Clip the plate area in such a way that only numbers of plate area extracted.
3. Separate each character from the plate.

5.1.5Number Identification

1. Create the template file from the stored template images.

2. Resize image obtained from segmentation to the size of template.
3. Compare each character with the templates.
4. Store the best matched character.

5.1.6Save to file in given format

1. Open a text file in write mode

2. Store the character obtained from the number identification process to text file in given format.
3. Close the file.

VI.RESULT ANALYSIS

6.1 Plate region extraction

Plate region extraction is the first stage in this algorithm. Image captured from the camera is first converted to the binary image consisting of only 1's and 0's (only black and white) by thresholding the pixel values of 0 (black) for all pixels in the input image with luminance less than threshold value and 1 (white) for all other pixels. Captured image (original image) and binarized image are shown in Figure 1(a) and 1(b) respectively[7].

Fig 6.1(a). Captured Image **Fig6.1 (b). Binarized Image**

The binarized image is then processed using some methods. To find the plate region, firstly smearing algorithm is used. Smearing is a method for the extraction of text areas on a mixed image. With the smearing algorithm, the image is processed along vertical and horizontal runs (scan-lines). If the number of white pixels is less than a desired threshold or greater than any other desired threshold, white pixels are converted to black. In this system, threshold values are selected as 10 and 100 for both horizontal and vertical smearing.

If number of 'white' pixels <10 ; pixels become 'black'.Else; no changeIf number of 'white' pixels >100 ; pixels become 'black',Else; no change.

After smearing, a morphological operation, dilation, is applied to the image for specifying the plate location. However, there may be more than one candidate region for plate location. To find the exact region and laminate the other regions, some criteria tests are applied to the image by smearing and filtering operation. The processed image after this stage is as shown in Figure 6.2 (a) and image involving only plate is shown in Figure 6.2(b).

Figure 6.2(a). Plate region **Figure 6.2(b). Extracted number plate**

6.2Segmentation

In the segmentation of plate characters, license plate is segmented into its constituent parts obtaining the characters individually. Firstly, image is filtered for enhancing the image and removing the noises and unwanted spots.enhancing the image and removing the noises and unwanted spots. Then dilation operation is applied to the image for separating the characters from each other if the characters are close to each other. After this operation, horizontal and vertical smearing is applied for finding the character regions. The next step is to cut the plate characters. It is done by finding starting and end points of characters in horizontal direction. The individual characters cut from the plate.

6.3 Character recognition

Before recognition algorithm, the characters are normalized. Normalization is to refine the characters into a block containing no extra white spaces (pixels) in all the four sides of the characters. Then each character is fit to equal size.

Fitting approach[7] is necessary for template matching. For matching the characters with the database, input images must be equal-sized with the database characters. Here the characters are fit to 36 *18. The extracted

characters cut from plate and the characters on database are now equal-sized. The next step is template matching. Template matching is an effective algorithm for recognition of characters. The character image is compared with the ones in the database and the best similarity is measured.

This system used the database as the Indian license plates characters all 36 alphanumeric characters (26 alphabets and 10numerals) with the size of 36*18.

Because of the similarities of some characters, there may be some errors during recognition. The confused characters mainly are B and 8, E and F, D and O, S and 5, Z and 2. To increase the recognition rate, some criteria tests are used in the system for the confused characters defining the special features of the characters. With these features of characters and applied tests during recognition algorithm, recognition In the segmentation of plate characters, license plate is segmented into its constituent parts obtaining the characters individually.rate is increased with the minimum error.

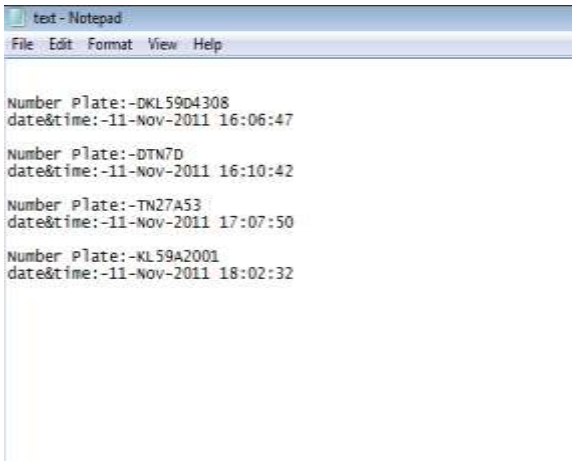


Fig.6.4 Output file

Figure 6.4 shows the real output of this work that the number plate of the vehicle is being entered into the database.

VII.CONCLUSION

In this work, we presented application software designed for the recognition of car license plate. Firstly we extracted the plate location, and then we separated the plate characters individually by segmentation and finally applied template matching with the use of correlation for recognition of plate characters. This system is designed for the identification Indian license plates and the system is tested over a large number of images.

Finally we had extracted the number plate region and the number is saved in the data base including the date and time of the entry of vehicle. We had also faced some limitations for our work done for example difficulty when high intensity light falls on the number plate, and also due to some standard size of Indian number plate.

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