

# ANPR for Developing Countries

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## Abstract

**Automatic Number Plate Recognition (ANPR) is a real time embedded system which automatically recognizes the license number of vehicles. In this paper, the task of recognizing number plate for Indian conditions is considered, where number plate standards are rarely followed.**

**The system consists of integration of algorithms like: 'Feature-based number plate Localization' for locating the number plate, 'Image Scissoring' for character segmentation and statistical feature extraction for character recognition; which are specifically designed for Indian number plates.**

**The system can recognize single and double line number plates under widely varying illumination conditions with a success rate of about 82%.**

## Introduction

ANPR is a mass surveillance system that captures the image of vehicles and recognizes their license number. Some applications of an ANPR system are, automated traffic surveillance and tracking system, automated high way/parking toll collection systems,

automation of petrol stations, journey time monitoring.

Such systems automate the process of recognizing the license number of vehicles, making it fast, time efficient and cost-effective.

## 1.1 Existing system

ANPR systems have been implemented in many countries like Australia, Korea and few others. Strict implementation of license plate standards in these countries has helped the early development of ANPR systems. These systems use standard features of the license plates such as: dimensions of plate, border for the plate, color and font of characters, etc. help to localize the number plate easily and identify the license number of the vehicle.

In India, number plate standards are rarely followed. Wide variations are found in terms of font types, script, size, placement and color of the number plates. In few cases, other unwanted decorations are present on the number plate. Also, unlike other countries, no special features are available on Indian number plates to ease their recognition process. Hence, currently only manual recording systems are used and ANPR has not been commercially implemented

in India. Christo Ananth et al. [1] proposed a system about Efficient Sensor Network for Vehicle Security. Today vehicle theft rate is very high, greater challenges are coming from thieves thus tracking/ alarming systems are being deployed with an increasingly popularity. As per as security is concerned today most of the vehicles are running on the LPG so it is necessary to monitor any leakage or level of LPG in order to provide safety to passenger. Also in this fast running world everybody is in hurry so it is required to provide fully automated maintenance system to make the journey of the passenger safe, comfortable and economical. To make the system more intelligent and advanced it is required to introduce some important developments that can help to promote not only the luxurious but also safety drive to the owner. The system "Efficient Sensor Network for Vehicle Security", introduces a new trend in automobile industry. Christo Ananth et al. [2] discussed about Intelligent Sensor Network for Vehicle Maintenance System. Modern automobiles are no longer mere mechanical devices; they are pervasively monitored through various sensor networks & using integrated circuits and microprocessor based design and control techniques while this transformation has driven major advancements in efficiency and safety. In the existing system the stress was given on the safety of the vehicle, modification in the physical structure of the vehicle but the proposed system introduces essential concept in the field of automobile industry. It is an interfacing of the advanced technologies

like Embedded Systems and the Automobile world. This "Intelligent Sensor Network for Vehicle Maintenance System" is best suitable for vehicle security as well as for vehicle's maintenance. Further it also supports advanced feature of GSM module interfacing. Through this concept in case of any emergency or accident the system will automatically sense and records the different parameters like LPG gas level, Engine Temperature, present speed and etc. so that at the time of investigation this parameters may play important role to find out the possible reasons of the accident.

Further, in case of accident & in case of stealing of vehicle GSM module will send SMS to the Police, insurance company as well as to the family members. Christo Ananth et al. [3] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day. "Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller. If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart

failure and therefore the controller stops the motor of the vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received. Christo Ananth et al. [4] discussed about a system, GSM based AMR has low infrastructure cost and it reduces man power. The system is fully automatic, hence the probability of error is reduced. The data is highly secured and it not only solve the problem of traditional meter reading system but also provides additional features such as power disconnection, reconnection and the concept of power management. The database stores the current month and also all the previous month data for the future use. Hence the system saves a lot amount of time and energy. Due to the power fluctuations, there might be a damage in the home appliances.

Hence to avoid such damages and to protect the appliances, the voltage controlling method can be implemented. Christo Ananth et al. [5] discussed about a system, in this project an automatic meter reading system is designed using GSM Technology. The embedded micro controller is interfaced with the GSM Module. This setup is fitted in home. The energy meter is attached to the micro controller. This controller reads the data from the meter output and transfers that data to GSM Module through the serial port. The embedded

micro controller has the knowledge of sending message to the system through the GSM module. Another system is placed in EB office, which is the authority office. When they send “unit request” to the microcontroller which is placed in home. Then the unit value is sent to the EB office PC through GSM module. According to the readings, the authority officer will send the information about the bill to the customer. If the customer doesn't pay bill on-time, the power supply to the corresponding home power unit is cut, by sending the command through to the microcontroller. Once the payment of bill is done the power supply is given to the customer. Power management concept is introduced, in which during the restriction mode only limited amount of power supply can be used by the customer.

## 1.2 Proposed system

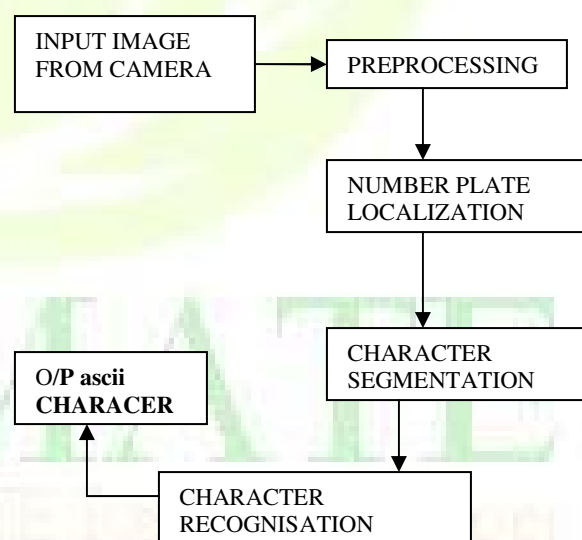


Fig.1. Software flow of the system

In designing this system (fig. 1), various Image Processing algorithms were designed in Matlab and implemented on the Digital Signal Processor TMS320DM6437 which is optimized for video and image processing applications.

A rear image of a vehicle is captured and processed using various algorithms. Initially, the number plate area is localized using a novel 'feature-based number plate localization' method which consists of many algorithms. This algorithm satisfactorily eliminates all the background noise and preserves only the number plate area in the image. This area is then segmented into individual characters using 'Image Scissoring' algorithm. After this step, the characters are extracted from the gray-scale image and each character is enhanced using some character enhancement techniques. These characters are given to the character recognition module, which uses statistical feature extraction to recognize the characters.

## 2. SYSTEM OVERVIEW

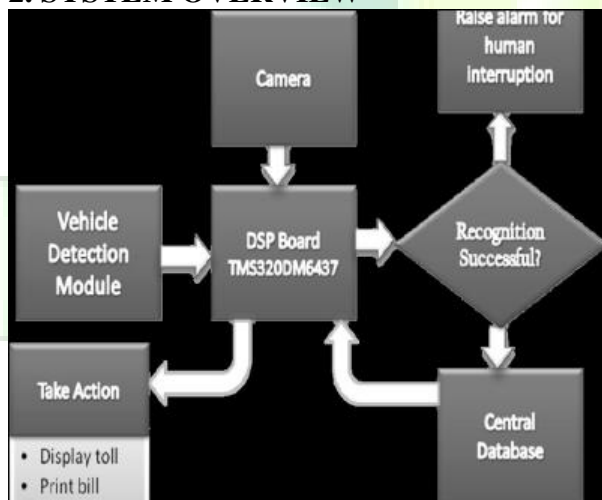


Fig.2. Output of step 1

Vehicle detection module detects the presence of vehicle by using inductive sensors in which metal wire loop is placed beneath the road. When a vehicle crosses the loop, there is change in induced current which detects presence of vehicle. As a result the DSP is interrupted and it triggers the IR camera to capture the image (fig. 2). The captured image is processed by DSP to recognize license number of vehicle by employing various image processing algorithms, as mentioned earlier. The DSP gives the license number in ASCII format, using which all relevant details about the vehicle are obtained from a centralized database.

Christo Ananth et al. [6] proposed a method in which the minimization is performed in a sequential manner by the fusion move algorithm that uses the QPBO min-cut algorithm. Multi-shape GCs are proven to be more beneficial than single-shape GCs. Hence, the segmentation methods are validated by calculating statistical measures. The false positive (FP) is reduced and sensitivity and specificity improved by multiple MTANN. Christo Ananth et al. [7] proposed a system, this system has concentrated on finding a fast and interactive segmentation method for liver and tumor segmentation. In the pre-processing stage, Mean shift filter is applied to CT image process and statistical thresholding method is applied for reducing processing area with improving detections rate. In the Second stage, the liver region has been segmented using the algorithm of the proposed method. Next, the tumor region has been segmented using Geodesic Graph cut method. Results



show that the proposed method is less prone to shortcutting than typical graph cut methods while being less sensitive to seed placement and better at edge localization than geodesic methods.

This leads to increased segmentation accuracy and reduced effort on the part of the user. Finally Segmented Liver and Tumor Regions were shown from the abdominal Computed Tomographic image. Christo Ananth et al. [8] proposed a system, in which a predicate is defined for measuring the evidence for a boundary between two regions using Geodesic Graph-based representation of the image. The algorithm is applied to image segmentation using two different kinds of local neighborhoods in constructing the graph. Liver and hepatic tumor segmentation can be automatically processed by the Geodesic graph-cut based method. This system has concentrated on finding a fast and interactive segmentation method for liver and tumor segmentation. In the preprocessing stage, the CT image process is carried over with mean shift filter and statistical thresholding method for reducing processing area with improving detections rate. Second stage is liver segmentation; the liver region has been segmented using the algorithm of the proposed method. The next stage tumor segmentation also followed the same steps.

Finally the liver and tumor regions are separately segmented from the computer tomography image. Christo Ananth et al. [9] proposed a system in which the cross-diamond search algorithm employs two diamond search patterns (a large and small) and a

halfway-stop technique. It finds small motion vectors with fewer search points than the DS algorithm while maintaining similar or even better search quality. The efficient Three Step Search (E3SS) algorithm requires less computation and performs better in terms of PSNR. Modified objected block-base vector search algorithm (MOBS) fully utilizes the correlations existing in motion vectors to reduce the computations. Fast Objected - Base Efficient (FOBE) Three Step Search algorithm combines E3SS and MOBS. By combining these two existing algorithms CDS and MOBS, a new algorithm is proposed with reduced computational complexity without degradation in quality. Christo Ananth et al. [10] proposed a system in which this study presented the implementation of two fully automatic liver and tumors segmentation techniques and their comparative assessment. The described adaptive initialization method enabled fully automatic liver surface segmentation with both GVF active contour and graph-cut techniques, demonstrating the feasibility of two different approaches. The comparative assessment showed that the graph-cut method provided superior results in terms of accuracy and did not present the described main limitations related to the GVF method. The proposed image processing method will improve computerized CT-based 3-D visualizations enabling noninvasive diagnosis of hepatic tumors. The described imaging approach might be valuable also for monitoring of postoperative outcomes through CT-volumetric assessments.

Processing time is an important feature for any computer-aided diagnosis system, especially in the intra-operative phase. Christo Ananth et al. [11] proposed a system in which an automatic anatomy segmentation method is proposed which effectively combines the Active Appearance Model, Live Wire and Graph Cut (ALG) ideas to exploit their complementary strengths. It consists of three main parts: model building, initialization, and delineation. For the initialization (recognition) part, a pseudo strategy is employed and the organs are segmented slice by slice via the OAAM (Oriented Active Appearance method). The purpose of initialization is to provide rough object localization and shape constraints for a latter GC method, which will produce refined delineation. It is better to have a fast and robust method than a slow and more accurate technique for initialization. Christo Ananth et al. [12] proposed a system which uses intermediate features of maximum overlap wavelet transform (IMOWT) as a pre-processing step. The coefficients derived from IMOWT are subjected to 2D histogram Grouping. This method is simple, fast and unsupervised. 2D histograms are used to obtain Grouping of color image. This Grouping output gives three segmentation maps which are fused together to get the final segmented output. This method produces good segmentation results when compared to the direct application of 2D Histogram Grouping.

IMOWT is the efficient transform in which a set of wavelet features of the same size of various levels of resolutions and different local

window sizes for different levels are used. IMOWT is efficient because of its time effectiveness, flexibility and translation invariance which are useful for good segmentation results. Christo Ananth et al. [13] proposed a system in which OWT extracts wavelet features which give a good separation of different patterns. Moreover the proposed algorithm uses morphological operators for effective segmentation. From the qualitative and quantitative results, it is concluded that our proposed method has improved segmentation quality and it is reliable, fast and can be used with reduced computational complexity than direct applications of Histogram Clustering. The main advantage of this method is the use of single parameter and also very faster. While comparing with five color spaces, segmentation scheme produces results noticeably better in RGB color space compared to all other color spaces. Christo Ananth et al. [14] presented an automatic segmentation method which effectively combines Active Contour Model, Live Wire method and Graph Cut approach (CLG). The aim of Live wire method is to provide control to the user on segmentation process during execution. Active Contour Model provides a statistical model of object shape and appearance to a new image which are built during a training phase. In the graph cut technique, each pixel is represented as a node and the distance between those nodes is represented as edges. In graph theory, a cut is a partition of the nodes that divides the graph into two disjoint subsets. For initialization, a pseudo strategy is employed and the organs are segmented

slice by slice through the OACAM (Oriented Active Contour Appearance Model). Initialization provides rough object localization and shape constraints which produce refined delineation.

This method is tested with different set of images including CT and MR images especially 3D images and produced perfect segmentation results. Christo Ananth et al. [15] proposed a work, in this work, a framework of feature distribution scheme is proposed for object matching. In this approach, information is distributed in such a way that each individual node maintains only a small amount of information about the objects seen by the network. Nevertheless, this amount is sufficient to efficiently route queries through the network without any degradation of the matching performance. Digital image processing approaches have been investigated to reconstruct a high resolution image from aliased low resolution images. The accurate registrations between low resolution images are very important to the reconstruction of a high resolution image. The proposed feature distribution scheme results in far lower network traffic load.

To achieve the maximum performance as with the full distribution of feature vectors, a set of requirements regarding abstraction, storage space, similarity metric and convergence has been proposed to implement this work in C++ and QT. Christo Ananth et al. [16] discussed about an important work which presents a metal detecting robot using RF communication with wireless audio and video transmission and it is designed and implemented with Atmel

89C51 MCU in embedded system domain. The robot is moved in particular direction using switches and the images are captured along with the audio and images are watched on the television. Experimental work has been carried out carefully. The result shows that higher efficiency is indeed achieved using the embedded system. The proposed method is verified to be highly beneficial for the security purpose and industrial purpose. The mine sensor worked at a constant speed without any problem despite its extension, meeting the specification required for the mine detection sensor. It contributed to the improvement of detection rate, while enhancing the operability as evidenced by completion of all the detection work as scheduled. The tests demonstrated that the robot would not pose any performance problem for installation of the mine detection sensor. On the other hand, however, the tests also clearly indicated areas where improvement, modification, specification change and additional features to the robot are required to serve better for the intended purpose. Valuable data and hints were obtained in connection with such issues as control method with the mine detection robot tilted, merits and drawbacks of mounting the sensor, cost, handling the cable between the robot and support vehicle, maintainability, serviceability and easiness of adjustments.

These issues became identified as a result of our engineers conducting both the domestic tests and the overseas tests by themselves, and in this respect the findings were all the more practical. Christo Ananth et al. [17] discussed about Vision based Path Planning and



Tracking control using Mobile Robot. This paper proposes a novel methodology for autonomous mobile robot navigation utilizing the concept of tracking control. Vision-based path planning and subsequent tracking are performed by utilizing proposed stable adaptive state feedback fuzzy tracking controllers designed using the Lyapunov theory and particle-swarm-optimization (PSO)-based hybrid approaches. The objective is to design two self-adaptive fuzzy controllers, for x-direction and y-direction movements, optimizing both its structures and free parameters, such that the designed controllers can guarantee desired stability and, simultaneously, can provide satisfactory tracking performance for the vision-based navigation of mobile robot.

The design methodology for the controllers simultaneously utilizes the global search capability of PSO and Lyapunov theory-based local search method, thus providing a high degree of automation. Two different variants of hybrid approaches have been employed in this work. The proposed schemes have been implemented in both simulation and experimentations with a real robot, and the results demonstrate the usefulness of the proposed concept. Christo Ananth et al. [18] discussed about a model, a new model is designed for boundary detection and applied it to object segmentation problem in medical images. Our edge following technique incorporates a vector image model and the edge map information. The proposed technique was applied to detect the object boundaries in several types of noisy images where the ill-defined edges were encountered. The proposed

techniques performances on object segmentation and computation time were evaluated by comparing with the popular methods, i.e., the ACM, GVF snake models. Several synthetic noisy images were created and tested.

The method is successfully tested in different types of medical images including aortas in cardiovascular MR images, and heart in CT images. Christo Ananth et al. [19] discussed about the issue of intuitive frontal area/foundation division in still pictures is of awesome down to earth significance in picture altering. They maintain a strategic distance from the limit length predisposition of chart cut strategies and results in expanded affectability to seed situation. Another proposed technique for completely programmed handling structures is given taking into account Graph-cut and Geodesic Graph cut calculations. This paper addresses the issue of dividing liver and tumor locales from the stomach CT pictures. The absence of edge displaying in geodesic or comparable methodologies confines their capacity to exactly restrict object limits, something at which chart cut strategies by and large exceed expectations. A predicate is characterized for measuring the confirmation for a limit between two locales utilizing Geodesic Graph-based representation of the picture. The calculation is connected to picture division utilizing two various types of nearby neighborhoods in building the chart. Liver and hepatic tumor division can be naturally prepared by the Geodesic chart cut based strategy. This framework has focused on finding a



quick and intuitive division strategy for liver and tumor division.

In the pre-handling stage, Mean movement channel is connected to CT picture process and factual thresholding technique is connected for diminishing preparing zone with enhancing discoveries rate. In the Second stage, the liver area has been divided utilizing the calculation of the proposed strategy. Next, the tumor district has been portioned utilizing Geodesic Graph cut strategy. Results demonstrate that the proposed strategy is less inclined to shortcutting than run of the mill diagram cut techniques while being less delicate to seed position and preferable at edge restriction over geodesic strategies. This prompts expanded division exactness and decreased exertion with respect to the client. At long last Segmented Liver and Tumor Regions were appeared from the stomach Computed Tomographic picture. Christo Ananth et al. [20] discussed about efficient content-based medical image retrieval, dignified according to the Patterns for Next generation Database systems (PANDA) framework for pattern representation and management. The proposed scheme use 2-D Wavelet Transform that involves block-based low-level feature extraction from images. An expectation-maximization algorithm is used to cluster the feature space to form higher level, semantically meaningful patterns. Then, the 2-component property of PANDA is exploited: the similarity between two clusters is estimated as a function of the similarity of both their structures and the measure components. Experiments were performed on a large set of reference radiographic images,

using different kinds of features to encode the low-level image content. Through this experimentation, it is shown that the proposed scheme can be efficiently and effectively applied for medical image retrieval from large databases, providing unsupervised semantic interpretation of the results, which can be further extended by knowledge representation methodologies.

### 3. Pre-processing and Number Plate Localization



Fig.3. Input gray-scale image.

A number of algorithms are suggested for number plate localization such as: multiple interlacing algorithm, Fourier domain filtering, and color image processing. These algorithms however do not satisfactorily work for Indian number plates since they assume features like: border for the plate, color of plate and color of characters to be present on the number plate. Christo Ananth et al. [21] discussed about E-plane and H-plane waveguides (Microwave Engineering) applicable to image processing. Christo Ananth et al.

[22] discussed about principles of electronic devices to explain this feature.

Hence, we designed and implemented 'Feature-based number plate localization' method well suited for Indian conditions. This approach consists of number of algorithms developed on the basis of general features of both, characters and number plate.

For pre-processing, the input gray-scale image (fig.3) is adaptively converted into binary image (fig. 4) using Ostu's method. This method is better suited for our application compared to other adaptive binarization methods like the Niblack's method.



Fig.4. Adaptively binarized image:  
Ostu's method

**Step 1:** A mask having shape of inverted 'L' and size equal to maximum possible character dimensions is rolled throughout the binary image. At every increment, a position is shortlisted as possible character location if: There is at least a single white pixel on the mask and there is at least a single white pixel on the immediate next row and column of the mask (fig 5).

**Step 2:** Size of each shortlisted character calculated. If it is less than half of

maximum possible character size that location discarded (fig.6)



Fig.5. Output of step 1



Fig.6. Output of step 2

**Step 3:** White pixel density of each probable character is calculated. If it is above 40% of total number of pixels, only then the location is preserved (fig. 7).



Fig.7. Output of step 3.

All the preceding steps are carried out in a single iteration to achieve time optimization.

**Step 4:** For a set of rows having height equal to maximum possible number plate height, white pixel density is calculated. If it is not above certain threshold, that area is discarded (fig. 8). Christo Ananth et al. [23] gave a brief outline on Electronic devices and circuits which is the basis for formation of patterns.

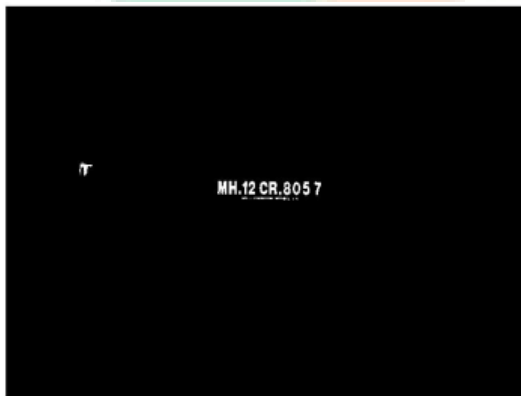


Fig.8. Output of step 4.

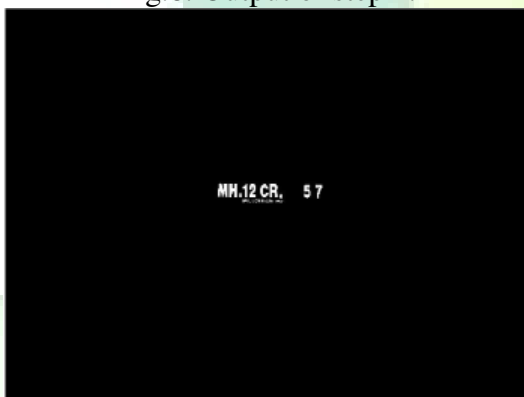


Fig.9. Output of step 5.

**Step 5:** For a set of columns having width equal to maximum possible number plate width, white pixel density is calculated. If it is not above certain threshold, that area is again discarded (fig. 9).

**Step 6:** Number of characters in the finalized number plate areas is calculated. If number of characters is less than four, then that area is discarded. If two number plate areas with nearly same number of characters are found in close vicinity of each other, then those areas are merged together.

After applying these steps, the number plate within the image is exactly located and all other background noise is eliminated. Number plate is now extracted (fig. 10) from the input binary image and is then eroded using square of size 2X2 which eliminates overlapping of characters before segmentation.

#### 4. Character Segmentation

Various methods like blob coloring, peak-to-valley method are suggested for character segmentation. However, these methods are not suitable for Indian number plates since they do not provide good results in cases where the characters are overlapping and are also timeconsuming.

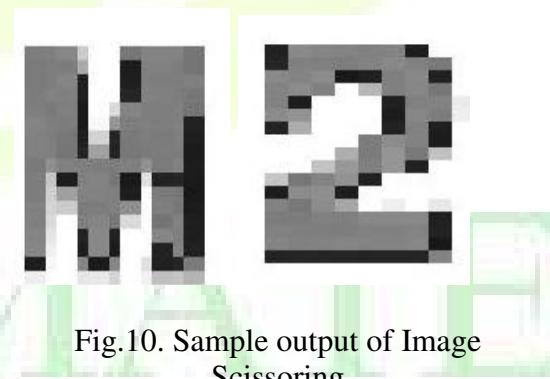


Fig.10. Sample output of Image Scissoring

To have reliability and time-optimization, a new 'Image Scissoring' algorithm is developed. In this algorithm, the number plate is vertically scanned and scissored at the row on which there is no white pixel (i.e., a blank row) and



the scissored area is copied into new matrix. This scanning procedure proceeds further in search of a blank row and thus different scissored areas are obtained in different matrices. Indian number plates can have either single or double rows. Hence, maximum two matrices must co-exist. To discard false matrices, heights of the matrices are compared. If the height of any of matrix is less than 1/4th of the height of tallest matrix, then the prior matrix is discarded. The same procedure is repeated horizontally on each matrix and using width as a threshold, individual characters are segmented (fig. 10).

### 5. Pre-recognition character enhancement

In this step, segmented characters are extracted from input grayscale image. Then each character is adaptively binarized using Ostu's method. After that, the binary character is scissored centered. These steps help to optimize the further recognition process (fig. 11).



Fig.11. Sample output after character enhancement

### 6. Character Recognition and Syntax Checking

This is the most critical stage of the ANPR system. Direct template matching can be used to identify characters. However, this method yields a very low success rate for font variations which are commonly found in Indian number plates.

Artificial Neural Networks like BPNNs can be used to classify the characters. However, they do not provide hardware and time optimization. Therefore statistical feature extraction has been used. In this method, initially the character is divided into twelve equal parts and fourteen features are extracted from every part. The features used are binary edges (2X2) of fourteen types. The feature vector is thus formed is compared with feature vectors of all the stored templates (fig. 13) and the maximum value of correlation is calculated to give the right character. Lastly syntax checking is done to ensure that any false characters are not recognized as a valid license number.

### 7. Experiments and Testing

The system was tested with a set of images not used during testing, having wide variations in illumination conditions. The complete recognition process takes an average of 2 seconds. This can be further improved by optimizing the code. If cases where the number plate script is non-English or the number plate is badly distorted are excluded then, 82% of the plates were recognized correctly. The performance of individual sections is: 87% for number plate localization, 95%

for character segmentation and 85% for character recognition.

## 8. Conclusions and Future Research

The system works satisfactorily for wide variations in illumination conditions and different types of number plates commonly found in India. It is definitely a better alternative to the existing manual systems in India.

Currently there are certain restrictions on parameters like speed of the vehicle, script on the number plate, skew in the image which can be aptly removed by enhancing the algorithms further.

## References

- [1] Christo Ananth, I.Uma Sankari, A.Vidhya, M.Vickneshwari, P.Karthiga, "Efficient Sensor Network for Vehicle Security", International Journal of Advanced Scientific and Technical Research (IJASR), Volume 2, Issue 4, March-April 2014, pp – 871-877
- [2] Christo Ananth, C.Sudalai@UtchiMahali, N.Ebenesar Jebadurai, S.Sankari@Saranya, T.Archana, "Intelligent sensor Network for Vehicle Maintenance system", International Journal of Emerging Trends in Engineering and Development (IJETED), Vol.3, Issue 4, May 2014, pp-361-369
- [3] Christo Ananth, S.Shafiq Shalaysha, M.Vaishnavi, J.Sasi Rabiyyathul Sabena, A.P.L.Sangeetha, M.Santhi, "Realtime Monitoring Of Cardiac Patients At Distance Using Tarang Communication", International Journal of Innovative Research in Engineering & Science (IJRES), Volume 9, Issue 3, September 2014, pp-15-20
- [4] Christo Ananth, G.Poncelina, M.Poolammal, S.Priyanka, M.Rakshana, Praghash.K., "GSM Based AMR", International Journal of Advanced Research in Biology, Ecology, Science and Technology (IJARBEST), Volume 1, Issue 4, July 2015, pp:26-28
- [5] Christo Ananth, Kanthimathi, Krishnammal, Jeyabala, Jothi Monika, Muthu Veni, "GSM Based Automatic Electricity Billing System", International Journal Of Advanced Research Trends In Engineering And Technology (IJARTET), Volume 2, Issue 7, July 2015), pp:16-21
- [6] Christo Ananth, G.Gayathri, M.Majitha Barvin, N.Juki Parsana, M.Parvin Banu, "Image Segmentation by Multi-shape GC-OAAM", American Journal of Sustainable Cities and Society (AJSCS), Vol. 1, Issue 3, January 2014, pp 274-280
- [7] Christo Ananth, D.L.Roshni Bai, K.Renuka, C.Savithra, A.Vidhya, "Interactive Automatic Hepatic Tumor CT Image Segmentation", International Journal of Emerging Research in Management & Technology (IJERMT), Volume-3, Issue-1, January 2014, pp 16-20
- [8] Christo Ananth, D.L.Roshni Bai, K.Renuka, A.Vidhya, C.Savithra, "Liver and Hepatic Tumor Segmentation in 3D CT Images", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), Volume 3, Issue-2, February 2014, pp 496-503
- [9] Christo Ananth, A.Sujitha Nandhini, A.Subha Shree, S.V.Ramya, J.Princess, "Fobe Algorithm for Video Processing", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), Vol. 3, Issue 3, March 2014, pp 7569-7574
- [10] Christo Ananth, Karthika.S, Shivangi Singh, Jennifer Christa.J, Gracelyn Ida.I, "Graph Cutting Tumor Images", International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE), Volume 4, Issue 3, March 2014, pp 309-314
- [11] Christo Ananth, G.Gayathri, I.Uma Sankari, A.Vidhya, P.Karthiga, "Automatic Image Segmentation method based on ALG", International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCCE), Vol. 2, Issue 4, April 2014, pp- 3716-3721
- [12] Christo Ananth, A.S.Senthilkani, S.Kamala Gomathy, J.Arockia Renilda, G.Blesslin Jebitha, Sankari @Saranya.S., "Color Image Segmentation using IMOWT with 2D Histogram Grouping", International Journal of Computer Science and Mobile Computing (IJCSMC), Vol. 3, Issue. 5, May 2014, pp-1 – 7
- [13] Christo Ananth, A.S.Senthilkani, Praghash.K, Chakka Raja.M., Jerrin John, I.Annadurai, "Overlap Wavelet Transform for Image Segmentation", International Journal of Electronics Communication and Computer Technology (IJECCT), Volume 4, Issue 3 (May 2014), pp-656-658
- [14] Christo Ananth, S.Santhana Priya, S.Manisha, T.Ezhil Jothi, M.S.Ramasubhaeswari, "CLG for Automatic Image Segmentation", International Journal of Electrical and Electronics Research (IJEER), Vol. 2, Issue 3, Month: July - September 2014, pp: 51-57
- [15] Christo Ananth, R.Nikitha, C.K.Sankavi, H.Mehnaz, N.Rajalakshmi, "High Resolution Image Reconstruction with Smart Camera Network", International Journal of Advanced Research in Biology, Ecology, Science and Technology (IJARBEST), Volume 1, Issue 4, July 2015, pp:1-5
- [16] Christo Ananth, B.Prem Kumar, M.Sai Suman, D.Paul Samuel, V.Pillai Vishal Vadivel, Praghash.K., "Autonomous Mobile Robot Navigation System", International Journal of Advanced Research in Biology, Ecology, Science and Technology (IJARBEST), Volume 1, Issue 4, July 2015, pp:15-19
- [17] Christo Ananth, Mersi Jesintha.R., Jeba Roslin.R., Sahaya Nithya.S., Niveda V.C.Mani, Praghash.K., "Vision based Path Planning and Tracking control using Mobile Robot", International Journal of Advanced Research in Biology, Ecology, Science and Technology (IJARBEST), Volume 1, Issue 4, July 2015, pp:20-25
- [18] Christo Ananth, S.Suryakala, I.V.Sushmitha Dani, I.Shibiya Sherlin, S.Sheba Monic, A.Sushma Thavakumari,



"Vector Image Model to Object Boundary Detection in Noisy Images", International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE), Volume 1, Issue 2, September 2015, pp:13-15

[19] Christo Ananth," Geo-cutting Liver Tumor", International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE), Volume 2, Issue 3, March 2016, pp:122-128

[20] Christo Ananth, K.Kalaiselvi, C.Kavya, S.Selvakani, P.Sorimuthu Iyan, "Patterns for Next generation Database Systems - A study", International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE), Volume 2, Issue 4, April 2016, pp: 114-119

[21] Christo Ananth, S.Esakki Rajavel, S.Allwin Devaraj, M.Suresh Chinnathampy. "RF and Microwave Engineering (Microwave Engineering)." (2014): 300, ACES Publishers

[22] Christo Ananth, S.Esakki Rajavel, S.Allwin Devaraj, P.Kannan. "Electronic Devices." (2014): 300, ACES Publishers.

[23] Christo Ananth, W.Stalin Jacob, P.Jenifer Darling Rosita. "A Brief Outline On ELECTRONIC DEVICES & CIRCUITS." (2016): 300.

[24] Leonard G. C. Hamey, Colin Priest, "Automatic Number Plate Recognition for Australian Conditions", Proceedings of the Digital Imaging Computing: Techniques and Applications (DICTA), pp. 14- 21, December 2005.

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