AUTOMATIC VEHICLE AUTHENTICATION SYSTEM USING MACHINE LEARNING

Shankar D. Chavan[1], Sushant S. Dhamapurkar[2]
Department of Electronics and Telecommunication Engineering,
Dr. D. Y. Patil Institute of Technology, Pimpri, Pune
India

Abstract: ***Vehicle authentication required in almost all public and private organisation is a time consuming and manpower involving process. Our idea is to develop an Automatic Vehicle Identification/Authentication System using Machine Learning which will help to minimize the time required and the manpower needed. Authentication of vehicle will be done by using license plate number. The system will take the image of the vehicle entering the organization, locate the number plate and by using concept of OCR and Image Processing will match the license number with the ones that are registered with the system. If the number matches then the vehicle will be given the access and if not, then access will be denied.***

Keywords: *Machine learning, OCR, image processing*

1. Introduction

Almost everything in this modern world is getting automated, for example Internet of Things. Every system that we see today is operated by some program or some machine; this is done to reduce human effort while increasing both quality and efficiency. One example is automatic gates that are deployed at various places. The gate open and close when a vehicle comes in front of them after getting checked by the security personnel.

Most of the organizations that deploy automatic gates need either a security guard to verify the identity of the person in the vehicle or an RFID tag-based system to verify the authenticity of the vehicle before granting it access to the parking space. Both of the above-mentioned system involves money, maintenance of the equipment and wastage of time, which the organization would like to get reduced because they want better results at the very little expense. This is where the heart of our project lies.

Our idea is to develop a Raspberry Pi based Automatic Vehicle Authentication System that will make use of only License Plate Number of the vehicle. The proposed system will eliminate the need of security guards and RFID Tag system, reducing the money factor as well as increasing speed of the verification process. The system will take the image of the incoming vehicle first and then make use of Image processing and Optical Character Recognition (OCR) for extracting the number from the number plate. After all the processing, the extracted number will be matched with the number present in the predefined number plate database. If the number matches with database, the vehicle will be given the access to the parking space or else an alarm signal will be generated. Also, to control the movement of the automatic gate, we are using an ultrasonic sensor. This will prevent the scenarios like closing the gate while a vehicle is passing.

Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV. Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality and OCR is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine encoded text.

2. Literature Survey

The classification of images is widely and wisely used technique in images processing. Deep learning is now very essential technique in image processing classification. In industries image classification is used to detect the fault in the manufactured product. We can apply the shallow machine learning and deep learning to identify the defect in the product. Here we can use the random forest classifier in the deep convolutional network to achieve better precision [1].

Image processing can be used to analyze the satellite images. The images capture by the satellite are travelled long distance and they are affected by the several noises and various environmental conditions. Also, images capture by the satellite are large in sizes so more noises are affected on the images, so there is need to analyze such images. There are various techniques to analyze the different types of images but there is need of common technique to analyze the all type of images [2].

In recent years the machine learning and image processing are mostly used in the industry sector. Mining is one of the industry sectors there is need of the image processing and machine learning to collection of the data and analyzing the collected data. By the image processing we can explore the different ways to apply the advance image processing with the help of machine learning to inspect the different mineral perspectivity mapping [3].

We can use the different image processing method such as normalization method in the machine learning. In the preprocessing of the image z-score normalization method is the most widely used method in image normalization. But with the z-score normalization we can use another preprocessing method such as histogram equalization to training the data in machine learning. So, use of the different image preprocessing method in machine learning algorithm is help to improve the result [4].

Road traffic is most common problem we are facing in day-to-day life. With the help of the machine learning it is easy to predict the traffic happen in road. There is various way that are tend to become traffic like environmental condition, repairing of the road, traffic signals, accidents, rallies, etc. In day-to-day life the traffic data increasing exponentially hence its lead towards the big data concept for the transportation. [5]

3. Proposed System

Currently, most of the organizations deploy security guards or RFID system for vehicle authentication. Security guard system need man power for work and this system is also time consuming. In RFID system we need to give every vehicle owner an individual tag and these tags also need regular maintenance. Hence the objective of this project is to develop a stand-alone system based on Raspberry Pi which can work on its own reducing man power requirement and cost involvement. Raspberry Pi is a central device used for the processing part in this project.
This research will help the organization to save money, time and human power used in one task of vehicle identification and then controlling the gate.
The same system with help of few modifications can be deployed in public parking area for maintain record of parking spots and generating parking tickets on basis of time that vehicle was parked for.

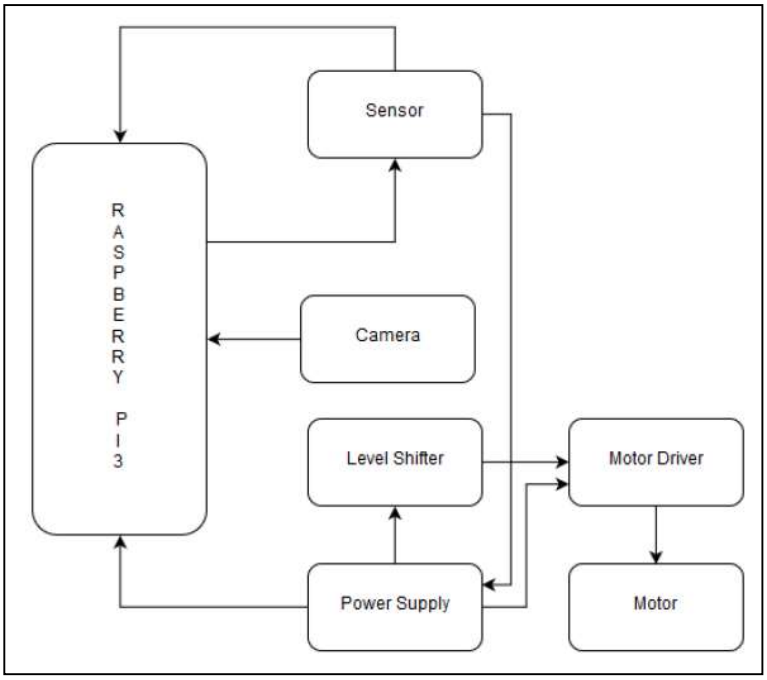

Figure 1. Block diagram of the proposed system

3.1 Software Development

Python is a widely used high-level programming language used for general-purpose programming. Python has a design philosophy which emphasizes code readability and a syntax which allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. Python is widely used and interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. Python is a wonderful and powerful programming language that's easy to use and with Raspberry Pi let you connect your project to the real world. Start by opening IDLE from the desktop. The Raspberry Pi is the best choice for any real time working system. Here USB camera can directly connect to the Raspberry Pi. Now, this camera can be used in our program. Since python is used as the programming language, using USB camera becomes very easy process. There are few processes that we have to do in machine learning are follows:

- Applying Filters to the Image:

  When the image of vehicle is taken, it cannot used directly as it contains noise, irregularity in brightness etc. which can give error in the output. Therefore, before further processing, various filters are applied on the taken image in order improve its quality. Noise filter, brightness adjustment, histogram equalization, enhancement etc. kind of filters can be used.

- Extracting the License Plate Number

  The system needs to extract the number from number plate in order to match it with the database. Optical character recognition (OCR) is used for this purpose. OCR is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image (for example from a television broadcast).
  For this purpose, we use an external library called Tesseract. It is an optical character recognition engine for various operating systems. It is free software, released under the Apache

License, Version 2.0 and development has been sponsored by Google since 2006. Tesseract is considered one of the most accurate open-source OCR engines currently available.

Authentication

- Matching the Number
  Once the number is extracted, it is matched with the preconfigured database of number plates. This is where the main authentication part takes place.

- Providing the Access
  If the extracted number plate from incoming vehicle matches with the numbers present in the database, the vehicle can enter the parking area and if it does not match then no access is given and an alarm is generated to notify the security personnel.

Controlling the Gate

To control the movement of the gate, an ultrasonic sensor is being used. Sensor is to be programmed is such a way that if in any circumstance a vehicle gets stuck between the gate, the gate should not get closed, hence preventing any kind of accident.

4. Result

The image of the vehicle is captured using a high-resolution camera. A better choice is an Infrared (IR) camera. The camera may be rolled and pitched with respect to the license plates. Character recognition is generally very sensitive to the skew. The readable characters can become distorted due to the obliqueness of the camera. Using a better camera with more definition and resolution will increase the success ratio of the system.

Figure 2. Captured image of the vehicle

The Fig.2 shows that the capture image of the vehicle and it transferred for the preprocessing. Pre-processing is the set algorithms applied on the image to enhance the quality. It is an important and common phase in any system.

Figure 3. Preprocessed image

The fig. 3 is preprocessed image. In preprocessing we are doing the two operations that are cropping and RGB to gray conversion. Cropping is the removal of the outer parts of an image to improve framing, accentuate subject matter or change aspect ratio. Images captured using IR or photographic cameras will be either in raw format or encoded into some multimedia standards. Normally, these images will be in RGB mode, with three channels (viz. red, green and blue). Number of channels defines the amount color information available on the image. The image must be converted to grayscale.

Figure 4. Vehicle number plate detection

Canny Edge Detection is a popular edge detection algorithm. By using the contour detection algorithm, we can easily find the square of the number plate. It approximates a contour shape to another shape with a smaller number of vertices depending upon the precision we specify. To understand this, suppose you are trying to find a square in an image, but due to some problems in the image, you didn't get a perfect square, but a "bad shape" Now you can use this function to approximate the shape. In Fig. 4 we can see that number plate is detected.

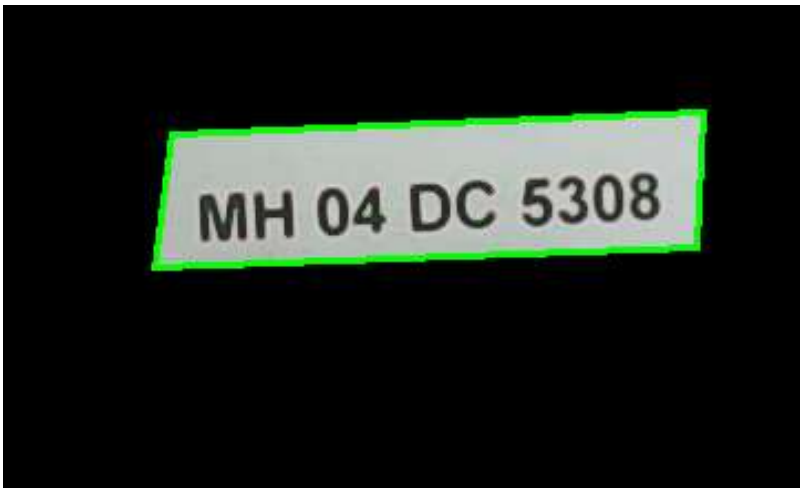

Figure 5. Extracting the number from the number plate

Using an image as a mask. A mask image is simply an image where some of the pixel intensity values are zero, and others are non-zero. Wherever the pixel intensity value is zero in the mask image, then the pixel intensity of the resulting masked image will be set to the background value (normally zero). Fig. 5 shows that the number has been detected by the number plate. From extracting the number from the number plate, it will send to our database for authentication. If the number will match with our database, then particular vehicle is allowed to enter in the premises.

5. Conclusion

The system designed is able give access to authorized vehicles automatically after doing the necessary checking. The system first takes the image of the incoming vehicle, then by using Image Processing it converts camera image into digital form. Some filters are applied to this image to reduce noise characters and enhance the quality of image for better result. This enhanced image then undergoes the process of OCR which extracts the number from the license plate of the vehicle. The number extracted is then matched with the predefined number plate database, when the number is matched with the existing database, then the vehicle is given access and the gate opens automatically. When the number extracted does not match with the database, the gate will remain close and the access will be denied.

6. Acknowledgement

The authors would like to sincerely thank Dr. D.Y. Patil Institute of Technology (DIT), and University of Pune for their valuable support and help for this research proposal.

7. References

1. Ando, H., Niitsu, Y., Hirasawa, M., Teduka, H., & Yajima, M. (2016). *Improvements of Classification Accuracy of Film Defects by Using GPU-accelerated Image Processing and Machine Learning Frameworks. 2016 Nicograph International (NicoInt).* doi:10.1109/nicoint.2016.15
2. Asokan, A., & Anitha, J. (2019). *Machine Learning based Image Processing Techniques for Satellite Image Analysis -A Survey. 2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon).* doi:10.1109/comitcon.2019.8862452

3. Ouanan, H., & Abdelwahed, E. H. (2019). *Image processing and machine learning applications in mining industry: Mine 4.0. 2019 International Conference on Intelligent Systems and Advanced Computing Sciences (ISACS).* doi:10.1109/isacs48493.2019.9068884
4. Ayumi Sada, Yuma Kinoshita, Sayaka Shiota, Hitoshi Kiya (2018). *Histogram-Based Image Pre-processing for Machine Learning*. 2018 IEEE 7th Global Conference on Consumer Electronics (GCCE 2018).
5. Meena, G., Sharma, D., & Mahrishi, M. (2020). *Traffic Prediction for Intelligent Transportation System using Machine Learning. 2020 3rd International Conference on Emerging Technologies in Computer Engineering: Machine Learning and Internet of Things (ICETCE).* doi:10.1109/icetce48199.2020.9091758

Authors Profile

Shankar Dattatray Chavan completed his Ph.D. in Electronics & Telecommunication Engineering under Savitribai Phule Pune University, Pune and Master of Engineering in Electronics under Shivaji University, Kolhapur. Currently is working as Associate Professor and PG Coordinator of Electronics & Telecommunication Engineering Department in Dr. D. Y. Patil Institute of Technology, Pimpri, Pune, Maharashtra, India, with an overall teaching experience of over 20 years at Undergraduate and Postgraduate level and Industrial experience of 5 years. He has guided more than 12 students towards post-graduation. He has more than 30 papers published in international conferences and reputed journal. His area of interest includes Wireless Sensor Networks and Power Electronics.

Sushant Sudhakar Dhamapurkar is pursuing his Masters of Engineering in Electronics and Telecommunication Engineering from Dr. D. Y. Patil Institute of Technology, Pimpri, Pune, Maharashtra, India.