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Image Recognition with Machine Learning

[1]Jyoti Choyal M. Tech. Student EC department[2] Ashish Ranjan Asst. Professor EC department
BM College of technology Indore, India.BM College of technology Indore, India.
Jyotichoyal1994@gmail.com * ashish150289@gmail.com**

Abstract:

The goal of this project is to use machine learning for image detection. Object detection suggests that finding the situation of the item and recognizing what it's. The techniques used for the item detection measure feature matching rule, pattern comparison and boundary detection. The feature-matching rule is employed to seek out the most effective matching object within the knowledge domain and to implement the reconstruction of the item recognized.

In the pre-treatment method we tend to 1st crop the image. once this we tend to convert the colour image to grey level image. once changing into grey level that image is filtered mistreatment 3 differing kinds of filters. they're average, Median, Weiner filters. once deciding the great filter we'll apply the segmentation method mistreatment edge detection.

Template matching technique uses the correlation procedure. we'll realize the coefficient of correlation between the 2 templates. Relying upon the coefficient of correlation we will realize that what proportion the 2 templates are just like one another. Machine learning teaches computers to do what comes naturally humans and animals: learn from experience. Machine learning algorithms use computational methods to "learn" information directly from data without relying on a predetermined equation as a model.

MATLAB provides an excellent platform to work with machine learning. it's wide selection of API's help in image recognition, processing and detection. It performs a platform to experiment with images and find the best solution.

Keywords: Image Recognition with Machine Learning, MATLAB, Weiner, Median.

1. INTRODUCTION

1.1 Machine Learning :

Machine Learning is a natural outgrowth of the intersection of Computer Science and Statistics.We Computer Science has focused primarily on how to manually program computers, Machine Learning focuses on the question of how to get computers to program themselves (from experience plus some initial structure). Whereas Statistics has focused primarily on what conclusions can be inferred from data, Machine Learning incorporates additional questions about what computational architectures and algorithms can be used to most effectively capture, store, index, retrieve and merge these data, how multiple learning subtasks can be orchestrated in a larger system, and questions of computational tractability [emphasis added]. There are some tasks that humans perform effortlessly or with some efforts, but we are unable to explain how we perform them. For example, we can recognize the speech of our friends without much difficulty. If we are asked how we recognize the voices, the answer is very difficult for us to explain. Because of the lack of understanding of such phenomenon (speech recognition in this case), we cannot craft algorithms for such scenarios. Machine learning algorithms are helpful in bridging this gap of understanding. The idea is very simple. We are not targeting to

understand the underlying processes that help us learn. We write computer programs that will make machines learn and enable them to perform tasks, such as prediction. The goal of learning is to construct a model that takes the input and produces the desired result. Sometimes, we can understand the model, whereas, at other times, it can also be like a black box for us, the working of which cannot be intuitively explained. The model can be considered as an approximation of the process we want machines to mimic. In such a situation, it is possible that we obtain errors for some input, but most of the time, the model provides correct answers. Hence, another measure of performance (besides performance of metrics of speed and memory usage) of a machine learning algorithm will be the accuracy of results. It seems appropriate here to quote another statement about learning of computer program from Professor Tom Mitchell from Carnegie Mellon University [4, p.2]: Machine learning is a branch of artificial intelligence that aims at enabling machines to perform their jobs skillfully by using intelligent software. The statistical learning methods constitute the backbone of intelligent software that is used to develop machine intelligence. Because machine learning algorithms require data to learn, the discipline must have connection with the discipline of database. Similarly, there are familiar terms such as Knowledge Discovery from Data (KDD), data mining, and pattern recognition. One wonders how to view the big picture in which such connection is illustrated. SAS Institute Inc., North Carolina, is a developer of the famous analytical software Statistical Analysis System (SAS).

1.2 Computer-Aided Diagnosis

Pattern recognition algorithms used in computer-aided diagnosis can assist doctors in interpreting medical images in a relatively short period. Medical images from different medical tests such as X-rays, MRI, and ultrasound are the sources of data describing a patient's condition.

1.2.1 Driverless Cars

Autonomous cars with no drivers are also one of the applications where car vision is actually made possible by advancement in the computer vision technology. In the industry.

1.2.2 Face Recognition and Security

Images from smart phones and CCTV cameras are now produced at an unprecedented rate. A problem pertinent to face recognition is to associate the face image to its respective identity. Building a classifier for this task is not a trivial job, because there are too many classes involved with multiple image-related problems.

1.3 MATLAB

MATLAB is a high-level language and interactive environment that enables you to perform computationally intensive tasks faster than with traditional programming languages such as C, C++ and Fortran.

MATLAB is an interactive, interpreted language that is designed for fast numerical matrix calculations

The Image Processing Toolbox is a collection of functions that extend the capabilities of the MATLAB's numeric computing environment. The toolbox supports a wide range of image processing operations, including.

– Geometric operations

– Neighborhood and block operations

– Linear filtering and filter design

– Transforms

– Image analysis and enhancement

– Binary image operations

– Region of interest operations

MATLAB can import/export several image formats

–BMP (Microsoft Windows Bitmap)

–GIF (Graphics Interchange Files)

–HDF (Hierarchical Data Format)

–JPEG (Joint Photographic Experts Group)

–PCX (Paintbrush)

–PNG (Portable Network Graphics)

–TIFF (Tagged Image File Format)

–XWD (X Window Dump)

Data types in MATLAB
–Double (64-bit double-precision floating point)

–Single (32-bit single-precision floating point)

–Int32 (32-bit signed integer)

–Int16 (16-bit signed integer)

–Int8 (8-bit signed integer)

–Uint32 (32-bit unsigned integer)

–Uint16 (16-bit unsigned integer)

–Uint8 (8-bit unsigned integer)

Images in MATLAB
Binary images : {0,1}
• Intensity images : [0,1] or uint8, double etc.
• RGB images : m × n × 3
• Multidimensional images: m × n × p (p is the number of layers)
•zoom - zoom in and zoom out of 2D plot

2. RELATED WORK

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subfield of digital signal processing, digital image processing has many advantages over analog image processing; it allows a much wider range of algorithms to be applied to input data, and can avoid problems such as the build-up of noise and signal distortion during processing.

An image may be defined as a two dimensional function, f(x,y) where x and y are spatial coordinates and the amplitude of f at any pair of coordinates(x,y)is called the
An image is denoted by two dimensional functions of the form f(x, y). In general, it is possible to divide previous passive studies into 2 parts. The one using Artificial Neural Networks and others using other methods. In Neural network systems, each character is introduced as an input data to the system. The system learns these characters. After that, it compares the input data characters to the existing characters. As a result, the character which has very similar rate is activated.
In this study, [1] is used for Inductive Learning Based Method and SVM method. Inductive Learning Based Method is used to divide all classes into smaller groups. SVM method is used for classification of these groups. All these methods are applied on the plate characters. Then, a training process is used for each character.
This system [2] is a web based system. This system consists of three modules:
• Creating digital image form the video signals, using hardware for this;
• Using pattern recognition and artificial intelligence for plate recognition;
• Accessing to the database from web browser and run query for vehicles
In this system [3] morphological operators are used for preprocessing. After preprocessing, Template Matching is used for character recognition. This system is used for Macao-style license plates.
In this study, it is the first time that the plate image is normalized [4]. Scaling and cross validation are applied for remove the outliers and find clear parameters for SVM method. Then use SVM method for character recognition. Correct recognition rate is higher than neural network systems.
This method [5] is applicable in camera-in-motion applications. Images are acquired via a webcam. The light conditions, background and position of the vehicle are not important for character recognition. This method can localize different sizes of the plate from the image. After localization of the plate, the characters are segmented. Multiple neural networks are used for character recognition. The correction rate is 95% in this method. This application was used in University of Malaga (Spain) in the entrance of the Computer Science building. [10]
Plate location is found by using plate background and the character's color in this study [7]. For segmentation, the column sum vector is obtained. The Artificial Neural Network is used for character recognition.

This system is designed for Islamabad Computerized Number Plates [8]. SCAN_NP algorithm is developed for plate extract. This algorithm can find candidate plates. The algorithm brings out these candidate objects which would turn out to be the plate characters. The objects have horizontal and vertical lines. This algorithm scans the image to remove the noises from the image. Neural Network and template matching is used for character recognition. The correction rate is 9% in this method.
This method [9] is used in off-line Thai license plate recognition. Hausdorff Distance technique is used for recognition. The correction rate in this method is %92.
This method [10] is used for Chine license plate recognition. The plate image is converted into a binary image. Then the noises are removed from the image. The

skeleton is used for generating the feature of the character. Then the character is normalized to size 8*16 pixels. The plate image is processed in the Back-Propagation Neuronal Network for recognition after being normalized. Back-Propagation Neuronal Network is used for character recognition [11].

3.Methodology

Object detection means finding the location of the object and recognizing what it is. The techniques used for the object detection are feature matching algorithm, pattern comparison and boundary detection. The feature matching algorithm is used to find the best matching object in the knowledge base and to implement the reconstruction of the object recognized.

There are two mainly two object recognition models.

1. The structural description model
2. Image base model

The first one believe that the main goal of the object recognition is to reconstruct the three dimensional description of the object. The second one believe that the regional features on the object are not sufficient to represent a 3D object and requires normalization and then by means of matching with similar view of the object to finalize the reconstruction. Object recognition algorithms such as feature fitting, template fitting, and boundary matching could be thought as the application of the above models. However recognizing an object based on the regional feature appears unstable, since different objects may have similar regional features. Either the structural description model or the image based model appears lack of consideration of shape knowledge.

Image Pre-treatment Process

Our object detection is to detect the license plate detection of the car. To detect the license plate of a car first pre-process the image. The pre-process of the image can be done as follows

3.1 Image Pre-treatment:

All vehicle images acquired through camera and image card are color image and image format is not same. The commonly used image forms are JPEG and BMP. If treatment with acquired image directly , not only the image format is complex, moreover the computation data quantity is extremely huge, such license plate location cannot satisfy the request for fast and real- time.

3.2 Gray Level

The given image is a colored image so convert that color image into gray level image using gray level conversion. The colored image contains red, green, blue colors.

3.3 Binary Level

An image consists of numeric values between 0 - 255. The numerical value of the picture is reduced to two values with binary level. Thus, a 8 - bit image is converted into 2 - bit format. The threshold value must be determined for this conversion. Using a fixed threshold value is not correct because of external factors such as sunlight, shadows at real-plate images.

value.

3.5 Histogram Equalization

Histogram equalization is used to improve color distribution where the image is not clear. In an image, if pixel values are clustered into a specific number, this clustering would be reduced by using histogram equalization.

3.8 Median Filter

It is a order static filter. Order static filters are non-linear spatial filters whose response is based on ordering the pixels contained in the image area encompassed by the filter, and then replacing the value of the center pixel with the value determined by the ranking result.

3.9 wiener filter

In this method the noise is consider as random variable and the objective is to find an estimate f^ of the uncorrupted image f such that the mean square error between them is minimized. This error is given by Where E(.)is the expected value of the argument. It is assumed that the noise and image are uncorrelated. That one or the other has zero mean and the intensity levels in the estimate are a linear function of the levels in the degraded image.

4.PRACTICAL MODEL

Segmentation of an image entails the division or separation of the image into regions of similar attribute. The basic attribute for segmentation is image amplitude-luminance for a monochrome image and colour components for a colour image. Image edges and textures are also useful attributes for segmentation.

Edge detection

Edge detection is an important step for image segmentation. The goal of edge detection process in a digital image is to determine the frontiers of all represented objects based on automatic processing of the colour or gray level information in each present pixel. To extract the edges from the images, derivative edge detection operators or gradient operator, such as Sobel

operator, Prewitt operator, Roberts‟s operator, and Laplacian operators are commonly used.

Algorithm

A pixel „p „ at coordinates (x,y) has four horizontal and vertical neighbours whose coordinates are given by (x+1,y),(x-1,y),(x,y+1),(x,y-1) This set of pixels called the 4-neighbors of „p „ is denoted by (p).Each pixel is a unit distance from (x,y).The four diagonals of „p „ have coordinates are (x+1,y+1),(x+1,y-1),(x-1,y+1),(x-1,y-1) And are denoted by (p).

Template Matching

After extracting the numbers and alphabets to read them we use template matching technique. Template matching is a technique in digital image processing for finding small parts of an image which match a template image. It can be used in manufacturing as a part of quality control, a way to navigate a mobile robot, or as a way to detect edges in images.

4.4 Results

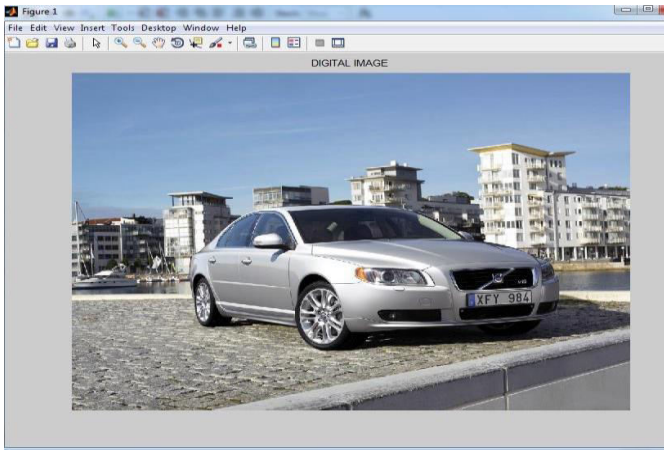

Figure 1: INPUT IMAGE FOR TESTING THE PROPOSED ALGORITHM

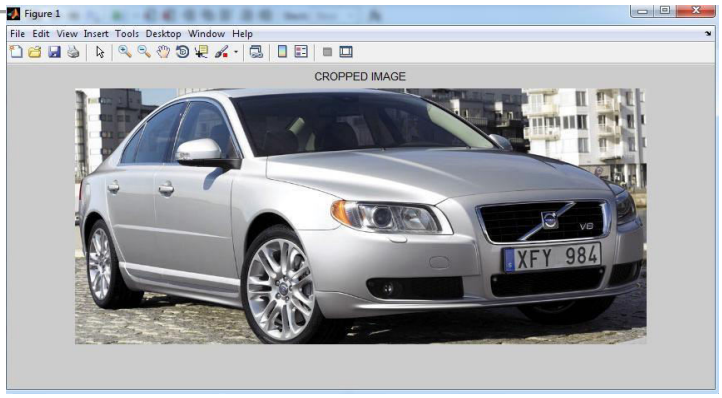

Figure 2: AFTER CROPPING USING THE IMAGE CROPPING TECHNIQUE

Figure 3: EDGE DETECTION USING “CANNY” OPERATOR

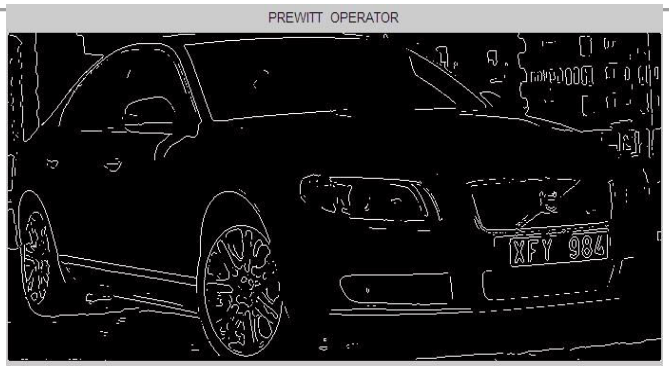

Figure 4: EDGE DETECTION USING "PREWITT" OPERATOR

Figure 5: EDGE DETECTION USING "SOBEL" OPERATOR

5.1 Future perspective of Work

The proposed system is implemented and tested with different scenarios with a set of image and found working perfectly. As the system development is done on a widely used MATLAB platform we get a chance to get into the vast library of it.

Present system gives a chance to learn machine learning and artificial intelligence technology, which is going to be widely used in near future.

- The platform can be changed as MATLAB is a paid platform, Python can be used.
- The image APIs used can be changed with other available API in reference of accuracy, efficiency etc.
- A complete image recognition product can be developed by assembling camera and a microcontroller or DSP system.
- The developed algorithm can be tested on vast sample of images to let the system learn and become more accurate in image recognition.

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