Deploying Face Detection, Motion Detection and Character Recognition using Smart Camera

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Abstract

In the modern day, cameras are one of the most used features. In fact cameras are so widely used that five of the top ten downloaded applications involve a camera. Thus cameras have remarkably blended in and adhered to our daily lifestyle. But apart from that cameras have many more applications in numerous other fields of technology. They are optical devices that can capture images and videos. Though a traditional camera is used to just capture images and videos, the application of cameras applies to many other fields, such as, security or surveillance cameras, or face unlock in mobile phones. Thus we try to improve a traditional camera by adding features like face recognition and motion detection to make it more technological. Our paper on Deploying Face Recognition and Motion Detection using Smart Camera basically combines several applications of camera which include Facial Recognition, Character Recognition and Motion Detection and accommodate all those features into a single package and discusses the methodology of its implementation.

Keywords: Face Detection, Image Processing

I. INTRODUCTION

The project Deploying Face Recognition and Motion Detection using Smart Camera provides users with three useful features, namely, Face Recognition, Character Recognition and Motion Detection. The application will use convolutional neural networks to detect and extract features, i.e., Faces or Characters and other techniques such as SVM to further recognize faces. The application will also use image processing techniques and Motion detection algorithms to detect motion in between frames.

Face Detection: In the past few years, face recognition owned significant consideration and appreciated as one of the most promising applications in the field of image analysis. Face detection can consider a substantial part of face recognition operations. According to its strength to focus computational resources on the section of an image holding a face. The method of face detection in pictures is complicated because of variability present across human faces such as pose, expression, position and orientation, skin colour, the presence of glasses or facial hair, differences in camera gain, lighting conditions, and image resolution.

Motion Detection: An important stream of research within a computer vision, which has gained a lot of importance in the last few years, is the understanding of human activity from a video. The growing interest in human motion analysis is strongly motivated by recent improvements in computer vision the availability of low cost hardware such as video cameras and a variety of new promising applications such as personal identification and visual surveillance. The goal of motion detection is to recognize motion of objects found in the two given images. Moreover, finding objects motion can contribute to objects recognition. Thus, the main objective of the research is to recognize pixels belonging to the same object.

Character Recognition: Detection of text and identification of characters in scene images is a challenging visual recognition problem. As in much of computer vision, the challenges posed by the complexity of these images have been combated with hand designed features and models that incorporate various pieces of high-level prior knowledge. In this paper, we produce results from a system that attempts to learn the necessary features directly from the data as an alternative to using purpose-built, text-specific features or models. Among our results, we achieve performance among the best known on the ICDAR 2003 character recognition dataset.

II. LITERATURE SURVEY

Some of the various techniques being practiced worldwide are discussed below.

A. Face Detection

Henry A. Rowley et al. 1998, proposed an algorithm that can detect between 77.9 and 90.3 of faces in a set of 130 test images, with an acceptable number of false detections. Depending on the application, the system can be made more or less conservative by varying the arbitration heuristics or thresholds used. The system has been tested on a wide variety of images, with many faces and unconstrained backgrounds.[1]

Ming-Hsuan Yang et al. 2002, provide a com-prehensive survey of research on face detection and to provide some structural categories for the methods described in over 150 papers. When ap-propriate, they have reported on the relative perfor-mance of methods. Although significant progress has been made in the last two decades, there is still work to be done, and we believe that robust face detection system should be effective under certain variations.[2]

Shashank Guo et al. 2016, propose an effective face recognition system based on CNN and SVM. In their system, CNN is used as a feature extractor and SVM is used as a classifier. In order to improve the performance of CNN, they use some optimization techniques to train CNN. They pre-train CNN with some ancillary data to improve the generalization ability of network, which takes much less time to extract facial features 1791 of target dataset.[3]

B. Motion Detection

Wang and Zhao proposed a motion detection by using background subtraction technique. In this video sequence is composed of a series of video images which contains the features of ge-ometry information of the target, extract relevant information to analyze the motion of targets then get detection results. The compression ratio was greatly improved. [4]

Rakibe and Patil presented motion detection by developing a new algorithm based upon the Background subtraction algorithm. In this firstly reliable background model based upon statistical is used. After that subtraction between the current image and background image is done based upon threshold. And then detection of moving object is done. After that, morphological filtering is initiated to remove the noise and solve the background interruption difficulty.[5]

Kavitha and Tejaswini presented motion detec-tion by overcoming the disadvantages of back-ground subtraction algorithm. In this robust an efficiently computed background subtraction algo-rithm has been used, which is able to cope with the problem of local illumination changes such as shadows and highlights as well as Motion De-tection Based on Frame Difference Method 1561 global illumination changes. [6]

Shafie et al. presented motion detection using optical flow method. Optical flow can arise from the relative motion of objects and the viewer so it can give important information about the spatial arrangement of the objects viewed and the rate of change of this arrangement. Discontinuities in the optical flow can help in segmenting images in to regions that correspond to different objects.[7]

C. Character Recognition

Yann LeCun et al. 1998, developed a gradi-ent based learning method that creates a neural networks to recognise handwritten digits in any image. They also provide various mechanisms to increase the efficiency of the neural network such as back propagation method. The dataset worked upon is the MNIST dataset.[8]

III. METHODOLOGY

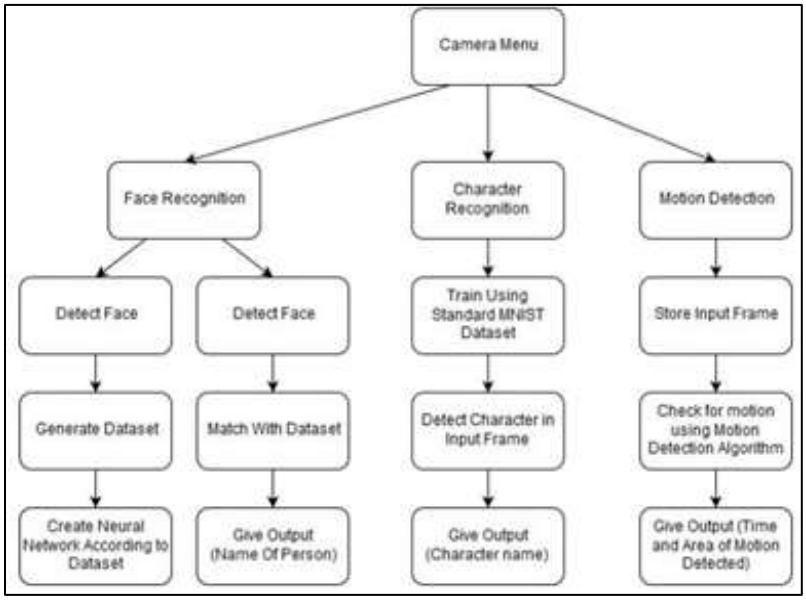


Fig. 1: Architecture of application

A. Face Detection

We are using HAAR CASCADES to detect faces in this application. Haar cascades makes use of the image subtraction morphological process to detect the face. In this the cascades of different images of the same person is taken and recorded in the database. All the pixels in the influence of white region are subtracted from all the pixels in the influence of black region. This method of subtraction is performed on each of the image in the cascade but all the images might not give us the best results. Many of the images have a lot of errors. The image with the least error is selected. The result of all the images are added together and is mentioned as weak classifier. As all the week classifiers are added together to form a strong classifier. Appling the subtraction process and determining each image error is a very time and space consuming process. Instead of applying it on each of the images the subtraction is applied on images one by one. If the last image is not a useful it is discarded.

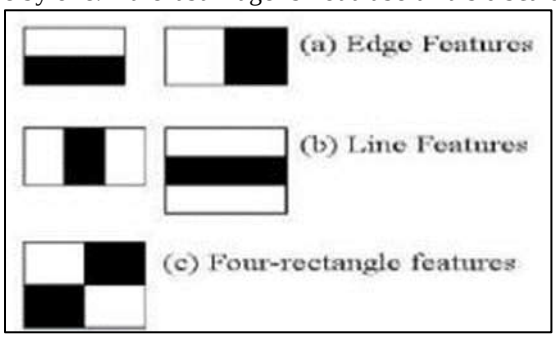


Fig. 2: Haar cascade Features

B. Motion Detection

Detection of moving object from a sequence of frames captured from a static camera is widely per-formed by frame difference method. The objective of the approach is to detect the moving objects from the difference between the existing frame and the reference frame. The frame difference method is the common method of motion detection. This method adopts pixel-based difference to find the moving object.

1) Difference of Two Consecutive Frames:

Ik is supposed to be the value of the kth frame in image sequences. Ik+1 is the value of the (k+1) th frame in image sequences. The absolute differential image is defined as follows:

$$Id(k, k+1) = —Ik+1 \; Ik— \quad ...(1)$$

Transformation of absolute differential image to

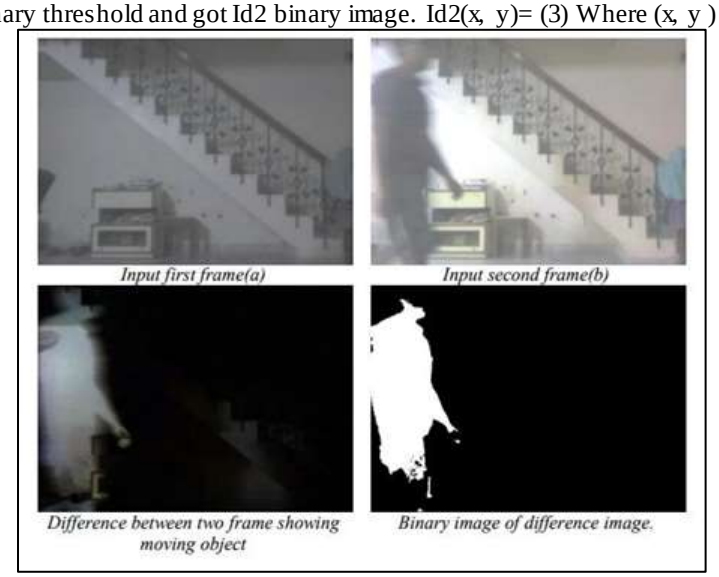
2) Gray Image:

There are holes in moving object area, and con-tour of moving object is not closed. The absolute differential image is transformed to gray image to facilitate further operations.

$$\text{RGB To Gray} : Y \; 0.299*R + 0.587*G + 0.114*B \quad ...(2)$$

3) Filtering and Binarizing Transformed Gray Im-age:

In order to remove the holes, the image is passed through the Gauss low pass filter. Id1is got by filtering the gray image. Now Id1image is binarized using binary threshold and got Id2 binary image. Id2(x, y)= (3) Where (x, y) is a pixel coordinates in image.

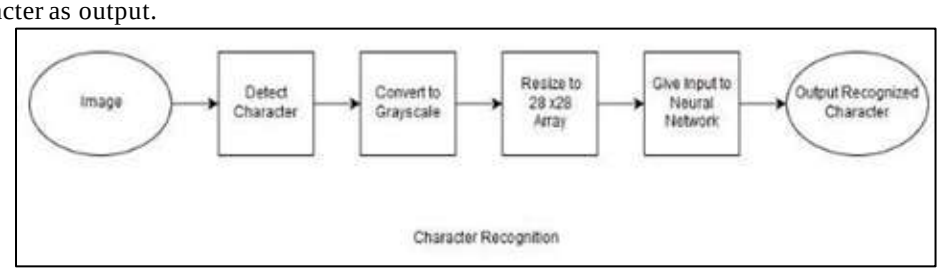


C. Character Recognition

Character Recognition has been implemented using a neural network trained using the MNIST Dataset for handwritten characters. The neural network takes an input of 28 x 28 array and gives an output array of size 62. The input is an image of handwritten character which is processed to grayscale and resized to a 28 x 28 array and later reshaped to 1 x 784 sized array. The output array elements denote the probability of that index element being the character in the image. The neural network consists of only one hidden layer with 40 neurons.

While training the neural network, a batch of 40 images is trained at once, and in total 128,000 images are used to train the network over 56 epochs. The neural network is then tested over 1000 images and then validated.

During the runtime, the sample image is first converted to a grayscale image and then resized to 28 x 28 sized array which conforms to MNIST dataset images. It is then given as input to the already trained neural network. The neural network gives the corresponding character as output.



IV. FUTURE SCOPE

The Project can have the following future scopes:

- Security/Counter-terrorism, Access control, comparing surveillance images to know per-sons identity.
- A character recognizer can be used to detect, recognize and store the handwritten characters. This reduces manual labour needed in task. .
- A motion detector can be used to detect movement or absence of it whenever needed. For example it can be used as a tiger tracker in a reserve.
- It can also be used with face detection for security in banks.
- Future efforts in the field of facial recognition may involve identification of expression based biometrics that can be used for automated security.
- Future scope in movement detection will be to resolve the problems of locating multiple objects separately in the real time scenarios.

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