

# Real-time information retrieval from Identity cards

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**Abstract**—Information is frequently retrieved from valid personal ID cards by the authorised organisation to address different purposes. The successful information retrieval(IR) depends on the accuracy and timing process. A process which necessitates a long time to respond is frustrating for both sides in the exchange of data. This paper aims to propose a series of state-of-the-art methods for the journey of an Identification card(ID) from the scanning or capture phase to the point before Optical character recognition(OCR). The key factors for this proposal are the accuracy and speed of the process during the journey. The experimental results of this research prove that utilising the methods based on deep learning, such as Efficient and Accurate Scene Text(EAST) detector and Deep Neural Network (DNN) for face detection, instead of traditional methods increase the efficiency considerably.

**Index Terms**—Image Segmentation, Optical character recognition(OCR), Document information Retrieval(DIR), Male/Female Recognition, Age detection Auto cropping, Skew detection

## I. INTRODUCTION

VALID ID cards which convey reliable and essential information about the cardholder have a vast range in terms of pattern, colour, template and text layout. However, most valid IDs follow the rule of predefined size based on the aspect ratio around 1.58 [1]. passports are a common, legal and internationally accepted proof of identification. The passport identity page includes an area in the bottom of the page which contains all essential fields of information in the specific structure. This area of interest is known as Machine Readable Zone(MRZ) [2]. MRZ data structure extraction and information retrieval is a relatively straightforward process due to its fixed size and location. However, identity cards such as a driver's license does not have an MRZ. Besides the lamination and texture pattern found in each ID card adds noise, thereby increasing the difficulty of the extraction process. Therefore, applying some preprocessing steps to remove this pattern before data extraction can support speed and accuracy. This study has two phases. The first phase is working around data extraction from a valid ID such as auto-cropping, locating horizontal, facial photo removal and text/non-text segmentation. The second phase attempts to represent an ideal method for data verification for information retrieval. This paper describe the first module. Furthermore, applying techniques such as age recognition, and female/male recognition modules after essential data extraction may be useful for data verification. IR results and the text extracted fields of data, images of the frontal facial photo, and cropped image of photo ID are saved in the new record a database. Two fields of images for keeping

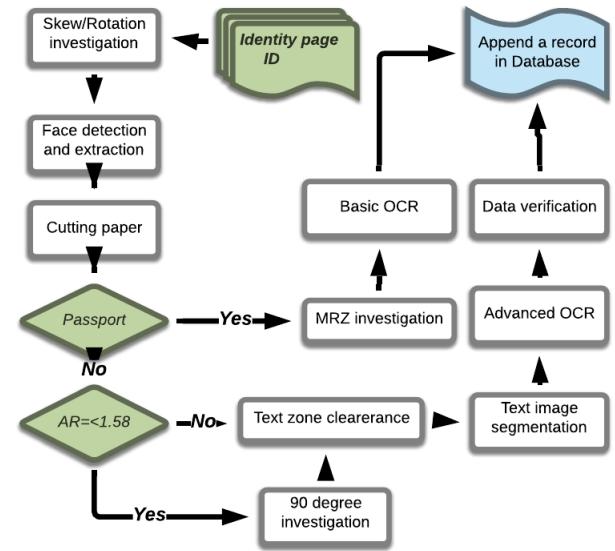


Fig. 1. The overview block diagram of information retrieval from an identity passport page

cropped photo ID and Personal photo are designed for each entry to support verification by the further offline investigation. The remainder of this paper includes two sections. Due to the modules multiplicity and diversity in structure and impact to the final result, this study has tried to present the related work, proposed method, and experimental results relevant to each module in an individual subsection. This presentation provides an opportunity for the reader to follow up, evaluate, and conclude each module separately in a logical manner. Section II contains all stated steps as sub-modules, which are started by meaning and concepts description followed by a literature review and proposed a method by this research in terms of time-saving and accuracy. Experimental results of each sub-modules are presented at the end of the relevant step to evaluate results. Section III consists of the conclusion and further development. The following block diagram(Figure 1) illustrates the overview of ID information retrieval.

Fig. 1: The overview block diagram of information retrieval from an identity passport page

## II. RELATED WORK AND PROPOSED METHOD

This section presents the processing modules before Optical character recognition(OCR) in the individual subsections. All modules for the journey of capturing device to saving in database are as follows:

- Skew and rotation detection/correction;
- Face detection and extraction;
- page area detection and calibration;
- pre-processing including pattern removal and increasing contrast;
- 90/180 rotated detection and correction;
- MRZ extraction and data retrieval;
- Text image segmentation and field data extraction;
- Running OCR based on language;
- Data verification (applying age detection, female/ male recognition and online signature verification),
- Save in database.

#### A. Skew/Rotation Investigation

In most cases, the scanned or captured identity page is not horizontal. Rotation or skew has a negative impact on the process of deriving accurate information. Former researchers recommended many approaches to address this issue. The general method to detect text rotation suggested by F Élix Abecassis [3] relies on finding the text of block, recognising the block angle and rotating the image based on the angle size. There are some approaches depending on text density in the document such as Duda et al. recommended utilising Hough line transform [4] followed by canny edge detector applied on grayscale image to calculate the Hough Transform values and peak determination. Then the detected peaks are categorised into different bins. The bins values denote the angle for correction. F. Weinhaus recommended applying Fast Fourier Transform (FFT) [5] spectrum conversion to documents which include many rows of texts and extracting the list of peaks orthogonal coordinates of text rows to calculate the Mean Square Error (MSE) from the list. In this method, line orientation indicates the angle for correction. However, these methods will not be able to recognise the 90/180 degree rotation in the document. The accuracy of these methods has a straightforward proportional relationship with the text density in the document. In the lack of sufficient text in the document, these methods have failed. This research to address the rotation issue has designed a pipeline includes FFT/MSE, Hough line transform/ Canny edge detection, and finally in F Élix Abecassis method. The evaluation results of these approaches by this research indicates that F Élix Abecassis transform has rarely failed and time efficient, which is less accurate than two others. Therefore, designing pipeline contains three methods provide a guarantee to obtain 96% true positive. Figures 2 and 3 show the result of the deskew processed by the designed pipeline in this research.

#### B. Photo Face Detection and Extraction

Face Detection module is performed to extract the facial photo. Applying Viola-Jones object detection based on HAAR cascade and Histogram of Oriented Gradient(HOG)/Linear Binary Pattern(LBP) leads to obtain different results in terms of accuracy and time(HOG is more preferred). Another method is Deep Neural Network(DNN) [6] that is a Residual Network(ResNet-10) Architecture utilising Single-Shot-



Fig. 2. +76.3797 degree rotated Identity page



Fig. 3. After applying first module

Multibox Detector(SSD) [7]. DNN result indicates that DNN is more robust under unpredictable conditions. Utilizing a DNN based face detection method indicates that in spite of the time-consuming process of loading a large size model file(almost ten times bigger than a required XML file for HAAR), DNN is faster than HAAR cascade and HOG(the time consumed by DNN is approximately 1/4 HAAR). Due to ethical considerations regarding utilization of frontal-face photographs of real people , this module does not present the results of applying DNN face detection and extraction of inappropriate resolution. Since the face boundary box is a square and the facial photograph is rectangular with an aspect ratio of 1.33, therefore for extracting the whole area of the picture, it is required to replace the facial photo with the black block based on new boundary box as follows:

$$BB_{face} = X_0; Y_0; W; H \quad (1)$$

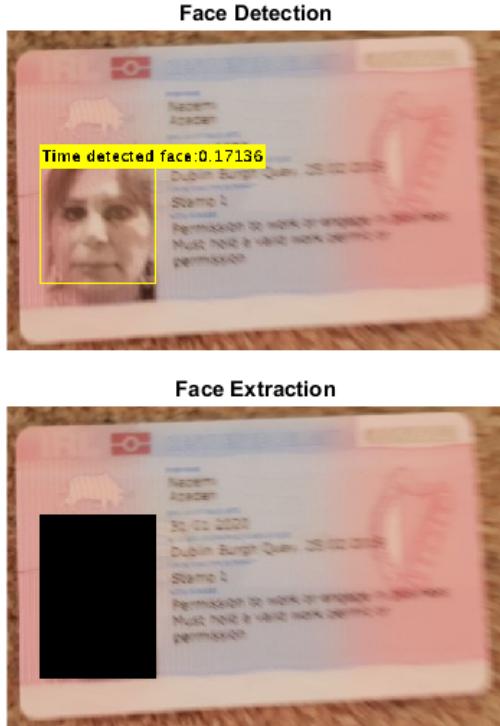


Fig. 4. Face detection and facial photo extraction using DNN

$$H_{PhotoID} = 1.3H \quad (2)$$

$$\Delta H = 1.3H - H \quad (3)$$

$$BB_{PhotoID} = X_0, Y_0 - \frac{\Delta H}{2}, W, H + \Delta H \quad (4)$$

The research evaluation for two methods denotes that DNN timing (0.17 seconds) about  $\frac{1}{8}$  HAAR/HOG (1.2 seconds) by improve accuracy from 89% to 96.3%. Figure 4-Top illustrates applying DNN face detection on a real ID card, and the Figure 4-Bottom is proof for utilizing Equation 4.

Fig 3 illustrates the inner class similarity of menders is more than their similarities to other classes (for saliency map). Fig 4 illustrates How the similarity of members of two different classes are more than the members inner class similarity(for intensity vectors)

### C. Auto cropping

The traditional primary method to detect the exact area of information is based on edge detection or horizontal/vertical line detection. Edge detection can not support auto cropping due to uncontrolled illumination conditions or in the case that locating paper under scanner/camera lens is not reliable [8]. This paper proposes a method based on high detail region detection. This method initially finds the best region containing the underlying detail in the image. Standard deviation, Sobel grayscale edges, or canny binary edges measure these details [9]. This area has the most critical grayscale mean. This approach tries to find the sub-image from the original

image with the lowest Root Mean Square Error(RMSE) [10]. Although, if the document contains only two regions based on detailed density, this method fails. Since this process is time-consuming, thus it is used for further offline processing, and another method has been replaced based on contour properties detection [11]. Besides, the contour properties support text/non-text segmentation modules. The following images respectively illustrate high detail extraction, and contour properties approach results applied for auto cropping. Figure 5-Top shows the captured image; Figure 5-Middle illustrates high detailed auto-cropping that is about 30 times slower than using auto-cropping based on contour property, which is illustrated in Figure 5-Bottom. The contour property based auto-cropping relies on the trusted area of text. The following steps recognise this area:

- Finding the biggest contour as a connected component. (level one).
- Finding level two contours inside level one.
- Keeping the level two contours which have most same level contour as a text line.
- Keeping Level two contours with aspect ratio ( $0 : 1 < \frac{Width}{Height} < 10$ )as a text character.

According to test implementation result for two stated methods, contour based auto cropping runs in real-time mode by timing 0.7 seconds. This research use the output of auto-cropping based on the specific area in the offline mode by timing 21 seconds for further verification.



Fig. 5. Top: Non-cropped captured the image, Middle: the result of high detail auto-cropping, Bottom: the result of grayscale contour property based auto-cropping

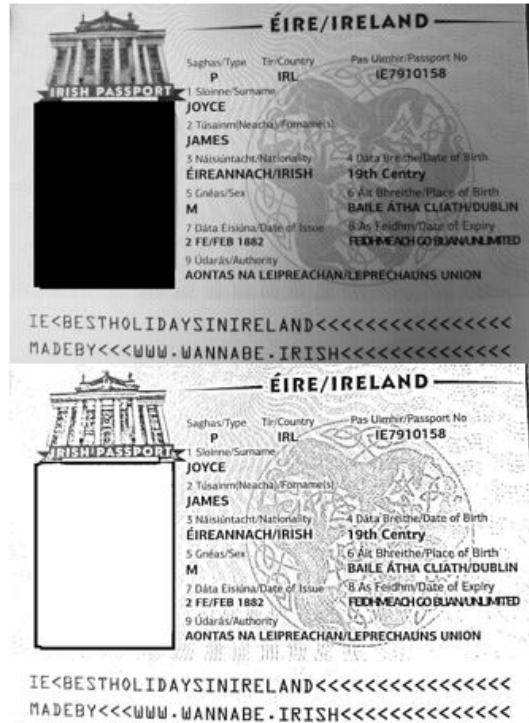


Fig. 6. Background cleaning Double steps.

#### D. Text cleaning

According to image processing researchers, noise reduction is a general approach to enhance text detection result [12]. Auto-cropping based on contour properties partially removes noise and cleans the text area. Usually, the background of the ID card has been affected by scanner/camera lens dust or dirt. This affection causes many conflicts with the result of the next module. Therefore, this research proposes text cleaning after auto-cropping for further enhancement. This text cleaning process is applied to the ID card and starts by converting the cropped image to the grayscale. The procedure continues by normalizing for enhancement purposes and converting to grayscale again. Afterwards, the enhanced grayscale image is converted to binary using the local threshold to create a mask by blurring, and finally, the obtained mask convolves to the original image to generate a clean background. In this stage, the result may require sharpening. Figure 6 shows two steps of background cleaning to improve the OCR result.

#### E. Text/non-text segmentation

One of the most significant modules that affect the final results is text/non-text segmentation, which is the area of research by many computer vision researchers. There are many successful approaches for this purpose, such as Maximally Stable External Region (MSER) [15], Stroke Width Transform (SWT) [14], and the most recent one is Efficient and Accurate Scene Text Detector(EAST) [13] based on deep learning. EAST detect words or text lines of arbitrary orientations and quadrilateral shapes, without need word, segmentation only using one Neural Network(NN). According to Huizhong Chen et. al. MSER represents robust and enhanced approach to

text detection.Chen used MSER with Canny edge to address MSER drawback caused by blurring. EAST is a state-of-theart deep learning model based on an innovative architecture and training pattern with timing performance about 0.07 for each frame. EAST is a suitable algorithm for extracting natural scene images. According to Celine Mancas-Thillou et al. 2017 in contrast, to text segmentation in laboratory conditions, this process from natural scene images is challenging due to non-predictable conditions such as low-resolution device capturing, noise, illumination, occlusion, deforming and positioning. However, in laboratory conditions, heuristic-based methods leading to obtaining a reasonable result for the real-time or natural scene is not straightforward. This study compares the result of MSER and EAST in terms of timing and accuracy. However, this comparison did not conclude with any exact result regarding the accuracy. The experimental results show that the EAST takes less time than MSER. SWT initially finds high contrast edges. Then traverses the image pixels' edge, in the normal direction to obtain another normal edge. This method leads to identify strokes, which is an element of finite width with two roughly parallel sides. These strokes play roles as a text area. SWT, due to its time-consuming nature, is not an efficient solution for this module. Besides, this module considers contour property based detection (used for auto-cropping) as an alternative. Figure 7 shows t based on contour. The text detection and character segmentation contrast to two stated approaches contour-based segmentation is character-based.

Figure 8 illustrates a sample of Text Detection of a passport page based on MSER.

Figure 9 illustrates a sample of Text Detection of a passport page using Deep Learning based on EAST.

#### F. Detecting 90 degree rotation

In general cases, two error conditions may indicate that the ID card does not locate horizontally.

- Before auto cropping: The face detection module, even if the image has been rotated180 degrees, detects the facial



Fig. 7. characterized contour based text segmentation



Fig. 8. MSER text segmentation



Fig. 9. EAST text segmentation

photo. Additionally, before the face detection module, any other rotation had been investigated. Therefore, in such a case which this module does not return any boundary box, it means the ID image was located vertically during image capture.

- After auto cropping: If the calculated aspect ratio of the cropping ID is not equal to the pre-defined layout.

In these cases to prevent failure in subsequent modules, it is required to rotate by 90 degrees before further investigation. Since 90 degree rotation is not detectable by the former modules, after auto cropping aspect ratio( Width Height ) of the ID card is calculated and if it is less than pre-defined layout 1.58, it is required to rotate the image 90 degrees. Besides, rotation of 90 degrees of the ID card before auto cropping leads to failure of the performance of face detection.

1) *MRZ investigation:* Based on the International Electrotechnical Commission MRZ includes two strings of 44 characters. The importance of MRZ is recognizable and readable by a machine, regardless of passport nationality. MRZ has two categories: Category one has three lines, and class 2 has two. MRZ provides information about the type of passport, passport type, validation date, passport holder name, full name, citizenship, and gender of the passport holder. Therefore, MRZ extraction is a verification tool for further data extraction. This research has used some morph techniques to detect and extract MRZ based on [16]. Blackhat morphological operation is suitable for releasing the black MRZ text against the light passport background. After applying this morph operation, the magnitude of the result is calculated. This module uses two kernels for further morphological operations. The first rectangular kernel with aspect ratio more than two removes blank areas between MRZ characters, and the square Kernel is used to insert blank space between MRZ lines. Figure 6-Top illustrates the mask of passport identity page after applying morphology techniques. Figure 6-Bottom shows extracted MRZ area.

## G. CONCLUSION

This research has been conducted to improve timing and accuracy information retrieval from identity card or passport. It aims to reduce the waiting time for checking and verification customer based on his/her claim upon presenting the ID. Based on this study, The journey of an ID card from capturing device to OCR includes many steps. Timing, accuracy, and



Fig. 10. Figure 6-Top: The mask of passport identity page after morphology techniques, Figure 6-Bottom: MRZ extracted area

performance of each step has been evaluating separately. Since the IR based on OCR result has straight proportional relation with the precision of text segmentation, this study attempts to find the most appropriate solution for the text segmentation. Although EAST is the robust and accurate text segmentation method for the wild scene, still it is sensitive to rotation, noise, and not proper margin. Therefore, this study attempts to find the most effective solution considering the timing for these issues. Experimental results prove that replacing MSER by EAST improves the timing from 0.7 to 0.07. However, the voting system finds the most interested area by MSER, EAST, and contour property. Comparing two auto-cropping approaches indicates that timing ratio is 30. It means, regardless of high obtained precision of finding the most detailed area that extracts the actual corners, this process is time consuming. Conclusively, finding the most significant connected component followed by detection of contour with the specific attribute plays an auto-cropping role. Regarding face detection and extraction, utilizing DNN increases accuracy about 10% and reduce the timing by about 0.75%. Although, for rotation and skew detection, FFT followed by MSE, for the document full of text record leads to 96% true-positive results, and using Hough transform followed by Canny edge obtain the more reliable robust report for the rotation probability. Therefore, to prevent failing this research uses a pipeline of three methods to address skew issues. Finally this research concludes that classifies implemented methods to real-time and offline. Further development and future work will follow this study by evaluating verification methods such as age, gender and signature recognition.

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