A Survey on using viola – jones in face detection and OCR in license plate detection.

Hanaa Mohsin Ahmed, shayma Ashor*

Computer Science Department, Technology University, Baghdad, Iraq

Abstract: With the increase in security risks, the need for intelligent and comprehensive security systems appears, providing a great amount of protection to reach some restricted places. The face detection and identification process play an important role in modern security systems, in addition to the systems matching the plate numbers of cars.

This study aims to focus on security systems that use viola-jones algorithms because of their prominent role in detecting faces in real time, in addition to, optical character recognition technique (OCR) that uses to identify and match the license plate number of cars. This study also focuses on diagnosing weaknesses in these systems in order to address them in the future.

KEYWORDS: viola-jones, OCR, histogram of oriented gradients (HOG), You Only Look Once (YOLO).

دراسة حول استخدام خوارزمية فيولا جونز في اكتشاف الوجوه وتقنية التعرف الضوئي على الحروف OCR في الكشف عن لوحات ارقام السيارة .

الخلاصة:

مع زيادة المخاطر الأمنية ، تظهر الحاجة الى أنظمة أمنية ذكية وشاملة ، توفر قدراً كبيراً من الحماية للوصول إلى بعض الأماكن المحظورة. تلعب عملية اكتشاف الوجه والتعرف عليه دورًا مهمًا في أنظمة الأمان الحديثة ، بالإضافة إلى انظمة مطابقة أرقام لوحات السيارات.

تهدف هذه الدراسة إلى التركيز على الأنظمة الأمنية التي تستخدم خوارزميات فيولا جونز لما لها من دور بارز في الكشف عن الوجوه في الوقت الحقيقي ، بالإضافة إلى تقنية التعرف الضوئي على الحروف (OCR) التي تستخدم لتحديد ومطابقة رقم لوحة ترخيص السيارات. تركز هذه الدراسة أيضًا على تشخيص نقاط الضعف في هذه الأنظمة من أجل معالجتها في المستقبل.

Introduction:

Preserve the security of people and institutions is one of the substantial issues of the current epoch due to serious security threats. Digital image processing techniques are excessively used to detect fraud and establish advanced security systems.

In this study, we will focus on research specialized in proposing systems to detect faces in real time, as well as systems for detecting and verifying license plate numbers. Paul Viola and Michael jones proposed a fast and accurate method to get facial position in the image in 2001[1]. Despite its advantages, but it contains some drawbacks that need to be addressed, such as its need for a large dataset for training, its sensitivity to light in the image, front face, and the time of the study depends on the number of classifiers and the size of the dataset used in the training. this method has become one of the most popular method to detect faces in real time later.

Viola is carried out in four basic stages: The first stage is the hair features, which is used to determine the presence of certain features in the image. Each feature results in a single value which is calculated by subtraction the sum of pixels under white rectangle from the sum of pixels under black rectangle. Some feature of haar can be seen in Figure 1[2].

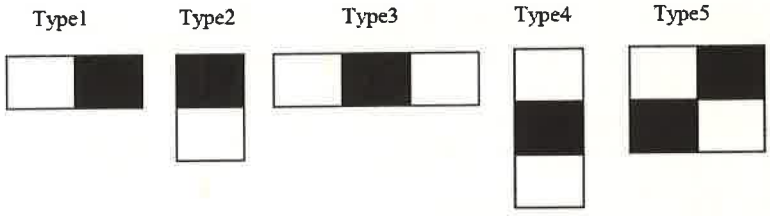
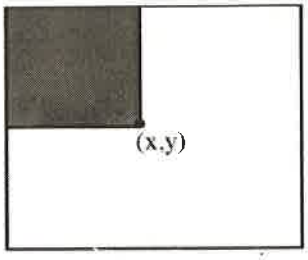


Fig (1) : Some feature of haar.

The second stage is the image integrity. This stage is used to overcome the problem of inefficiency resulting from calculating the values of the features for a large set of features because the process of computing the rectangular features rapidly considered critical as shown in the following figure (2) and equation(1)[3].



$$ii(x,y) = \Sigma\, i(x',y')$$

Figure (2): image integral.

In the third stage, a machine learning algorithm called AdaBoost is used to structure a strong classifier from a collection of a set of weak classifiers.

In the fourth stage, a cascade classifier is used which includes many stages, each one containing a strong classifier. So all the features are collected into several stages where each stage has a certain number of features. The job of each stage is used to determine whether a given sub window is definitely not a face or may be a face. A given sub window is immediately discarded as not a face if it fails in any of the stage as shown in figure(3)[4].

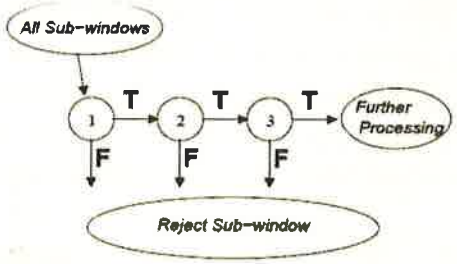


Figure (3): the cascade classifier.

Optical Character Recognition (OCR) is used to extract features of character from the image by converts it into a machine editable format. Many applications use OCR to recognition license plate numbers such as parking, Detecting accidents and stealing cars, monitor traffic. The process of OCR is a composite activity comprises different phases. These phases are as follows: In the first phases, a camera or scanner is used to capture images. In the second phase, the image quality is amended with different pre-processing steps. In the third phase, the characters are segmented and separated in the image. In the last phrase, the image is classified according to the features extracted from the previous phrase

There are studies proposed merging between both face detection and license plate number identification to reside integrated security systems that will be discussed in this study as well.

Literature Review

Narayan T. Deshpande and Dr. S. Ravishankar, 2017. Proposed a methodology depends on the features derived from the image to recognize the faces. The proposed system is carried out in two steps. The first step used the viola- Jones algorithm to detect the face in the image. In the second step, Faces are recognized by using the Neural Networks algorithm and Principle Component Analysis for faces detected in the first step. The system achieved high accuracy after it was trained and tested using Bio ID-Face-Database[5].

Edy Winarno, Wiwien Hadikurniawati1, Ahmad Ainun Nirwanto and Dahlan Abdullah, 2018. The proposed system facilitates count the number of faces in an image. The system uses the Viola Jones method to get the number of people that can be detected and the result can be saved. The system has achieved results that reach up to 93.7% in the images with good lighting, but the accuracy has decreased significantly with the reduction of the lighting in the images[2].

Emre Dandıl, Rıdvan Özdemir, 2019. Proposed system capable of detecting faces and identifying emotion (anger, happy...) with very high accuracy in real time using the CNN. They used dataset collected from public color images available for free to train 5-layer CNN. The data set contains 33600 images that are classified according to facial expressions into six groups (happy, sad, anger, surprise, fear, and neutral emotions). 3360 images were used for training and 240 for testing. The system achieved an accuracy of up to 100% for feelings of happiness, as well as achieved accuracy of up to 89% for feelings of sadness, and achieved the lowest accuracy for feelings of anger, reaching 80%[6].

Issam Dagher and Hussein Al-Bazzaz, 2019. Proposed system improves the ability to recognize faces using the Weighted Voting Technique for face components after detection by using viola jones. The facial components are detected and cropped accurately during all pose-changing circumstances. .e cropped components are represented by the histogram of oriented gradients (HOG). The system used three different types of databases (AT&Tdatabase, the PUTdatabase, and the AR database) and achieved good results[7].

Amal A. Moustafa · Ahmed Elnakib · Nihal F. F. Areed, 2019. Proposed system to Age-invariant face recognition. The proposed system is divided into four phases, the first stage is the face detection stage in which the viola algorithm has been used. In the second stage, CNN used the extraction feature, the third stage is the feature fusion stage, which significantly reduces feature dimensions, and the last stage is the classification stage using K-nearest neighbor and support vector machine, the system. The system achieved high accuracy results[8].

Safaa S. Omran and Jumana A. Jarallah in 2017. They presented an application program for identifying Iraqi car license plate numbers using OCR. The application is used three models of Iraqi license plate numbers written in the Arabic language. The system first locates the plate and then extracts the plate characters by segmentation, finally, recognition license plates by applying template matching and correlation. The system examined 40 images, colored and different in size and light. The system classified 35 images only due to the noise present in the remaining five image that the system could not classify. It achieved 86.6% accuracy [9].

Fei Xie , Ming Zhang ,Jing Zhao , Jiquan Yang, Yijian Liu, and Xinyue Yuan1 in 2018. Proposed a new license plate recognition algorithm depending on an integrated feature extraction model with BPNN (Back propagation Neural Network) which able to address complicated background and Lighting changes. The proposed system achieved high results, reaching 97% in detection and identification of license plate numbers, with complex backgrounds and dark images[10].

Atefeh Ranjkesh Rashtehroudi , Asadollah Shahbahrami, Alireza Akoushideh, 2020. Proposed Automated License Plate Recognition (ALPR) system used to recognize the Iranian License Plate. The proposed system consists of three main stages: localization, segmentation,

OCR. They used deep learning techniques such as the You Only Look Once (YOLO) framework to improve the OCR performance by integrating both segmentation and OCR steps as a single-stage. Compared with the previous system, the proposed system achieved accuracy up to 99.2[11].

MUHAMMAD YASIR ZAHEEN, ZIA MOHI-U-DIN, ALI AKBAR SIDDIQUE, AND MUHAMMAD TAHIR QADRI , 2020. They proposed a comprehensive building security system using MATLAB to detect faces and license plate numbers. They proposed using two cameras, the first one used to capture image of the driver's face. The viola jones algorithm used to detect the face in the image. Information about the face components (the distance between the eyes, mouth, and nose) is collected and placed in a database. Machine learning algorithm used to recognize faces. The second camera used to capture the image of the license plate, then OCR is used to recognize the license plate number. The information extracted from the two cameras is combined to verify the driver's identity. The system achieved an accuracy of 83%, but the accuracy decreased to 40% for dark images[12].

Ghaida Saadouli, Maha Ibrahim Elburdani, Razan Mohammed Al-Qatouni, Suchithra Kunhoth, Somaya Al- Maadeed,2020. They proposed combining three models: car make and model, license plate, and face detection to create an automatic gate system. To stop the car when it reaches the gate and capture the image, they proposed using the ultrasonic sensor detects. also, the proposed system uses feature extraction algorithms based on Difference of Gaussians (DoG) detector and Scale Invariant Feature Transform (SIFT) descriptor to detect The car make and model. To detect the face of the driver, used the viola jones algorithm. Car plate recognizes by using optical character recognition (OCR) and connected components identification. Then the proposed system combined the three models to create an integrated security system. The database was created using a surveillance camera to take pictures of various types of Qatari cars. The system achieved an accuracy of 75%[13].

Table1- illustrates the difference between the above works.

Author's name	Aim of work	Tools	Dataset	illuminatio n	Accura cy
Narayan T. Deshpande and Dr. S. Ravishankar	proposed a methodology for recognizing the human face based on the features derived from the image	Viola-Jones , *PCA and ANN*	Bio ID-Face	The complexit y of calculation s and time	94%
Edy Winarno,	The system	Viola-	40 image	it does not	93.7%

Wiwien Hadikurniawati1, Ahmad Ainun Nirwanto and Dahlan Abdullah, 2018.	facilitates count the number of faces in an image by using viola-jones.	jones		address dark image	
Emre Dandıl, Rıdvan Özdemir,	Proposed System capable of detecting faces and identifying emotion (anger, happy...) with very high accuracy in real time using the CNN.	Viola jones, CNN	https://stock.adobe.com/search/images	The complexity of calculations and time	Happy= 100% Anger= 80% Sad=89 %
Issam Dagher and Hussein Al-Bazzaz	proposed system improves the ability to recognize faces using the Weighted Voting Technique for face components after detection by using viola jones	Viola-jones, HOC	AT&Td, PUT, AR database	Accurse decreases with low brightness images	AT&Td =96 PUT=100% AR=94 %
Amal A. Moustafa · Ahmed Elnakib · Nihal F. F. Areed.	Proposed system to Age-invariant face recognition.	Viola jones, CNN,KNN,SVM	FGNET, MORPH	The complexity of calculations	FGNET = 81% MORPH=96.5 %
Safaa S. Omran and Jumana A. Jarallah	Iraqi license plate numbers recognition	OCR , template matching and correlation	Captured by a camera	Inability to classify images with high noise.	86.6%
Fei Xie ,	proposed system to	OCR ,	100	Complexit	97%

Ming Zhang ,Jing Zhao , Jiquan Yang, Yijian Liu, and Xinyue Yuan1	identify license plate numbers, with complex backgrounds of images and low lights.	BPNN	image Captured by a camera	y in computation	
Atefeh Ranjkesh Rashtehroudi , Asadollah Shahbahrami, Alireza Akoushideh	Improve OCR by combine it with segmentation by using YOLO to sing it To identify license plate.	YOLO	1000 image capture by surveillance cameras	Complexity in computation	99.2%
MUHAMMAD YASIR ZAHEEN, ZIA MOHI-U-DIN, ALI AKBAR SIDDIQUE, AND MUHAMMAD TAHIR QADRI	Exhaustive Security System Based on Face Recognition and Number Plate Identification	Viola jones , OCR	50 image capture by surveillance cameras	it does not address dark image	83%
Ghaida Saadouli, Maha Ibrahim Elburdani, Razan Mohammed Al-Qatouni, Suchithra Kunhoth, Somaya Al-Maadeed	To create an automatic gate system by integrated between three models : car marke and model , license plate , face detection.	OCR, DoG and SIFT, viola jones	225 image capture by surveillance camera	Precision is low because it does not address images that suffer from the problem of low lighting and high noise	75%

Conclusion

In recent years, the need for efficient security systems increases to keep people safe. We studies a set of systems that focus on face detection using the Viola jones algorithm and car license plates using OCR. We concluded that the best results were achieved when using deep learning algorithms despite the complexity of the computation. There are systems that integrate between face detection and number plates to create integrated systems, but these systems did not address noise-related problems in the images ,therefore, the accuracy was low when classification the images with low lighting and high noise.

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