Application of QR Code Detection and Decoding to secure Cloud Storage usingDarknet and YOLO

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Abstract:

Cloud storage is an inconsistently rising technology that is used globally. Financial organizations and departments are the ones that most frequently need to decode the QR codes of the documents. They do it manually, which is time-consuming as well as cumbersome. QR code detection is a challenging problem statement with subdomains of manual intervention and error. The idea of the approach should be with a design of automation having accurate detection and decoding of a QR code. In this paper, the technology stack includes a YOLO (You look only once) object detection scheme where a darknet is integrated to detect a QR code in an image or a pdf. The system design is robust in nature and deals with various formats and a trained model that knows to detect the QR code from that document. In this project, image quality is also addressed and improved using GAN (Generative Adversarial Network). The best quality image is selected, and a trained model will detect the QR code and crop it so the frame will be a lossless object. The final step is decoding the QR code using frameworks like pyzbar, OpenCV, qrtools, and PIL. The combination of these terms and frameworks turned out to be an integrated, scalable, and ready-to-use product. The stepwise explanation is given, and, in each section, there are various frameworks and tools used. The research on detecting the QR code is reflected in this paper's multiple experiments on the documents.

Keywords – Cloud storage, YOLO (You look only once), GAN (Generative Adversarial Network), pyzbar, OpenCV, and PIL, qrtools

DOI Number: 10.14704/nq.2022.20.9.NQ44546 Neuro Quantology 2022; 20(9):4709-4714

Introduction

Cloud technology has become a part of almost every individual's everyday life. On-demand computing clients, as well as contributors, need protection against data loss and theft. Users consistently upload their data and documents on the cloud storage to keep them in access whenever and wherever required. Financial organizations and related users frequently use the cloud storge to store their documents. Detecting a QR code in a document is necessary for domains like retail, accounts, and other financial services. The problem is that without this service, users need to open the pdf or receipt where a QR code is embedded.

In most cases, the location of the QR code is very dynamic and can be of any size. Also, the quality of the QR code matters a lot. If the quality is not up to the mark, the QR code will never get decoded [1-6]. These problem statements are large enough to be addressed. The system designed and described in this research paper deals with without opening pdf and scanning manually. The user can upload the pdf on UI, and the decode QR code will be given that can be used directly or stored in the database. This will save any manual intervention of opening the pdf or doc and then scanning through phones or other scanners. Instead, the service will do steps like converting doc to Image, detecting QR code, Cropping and saving the detected QR code, and running the scanner automated service todecode the QR code in the background.

The scalability is maintained by the cloud services like Docker and Kubernetes frameworks on AWS EC2. The load balancer in a cloud environment is also there as most things happening in the background need computational power and time to return the results or decoded value to the user in less time.

The number of requests can be anything, so a load balancer is very much required in this process. Also, the document supported various formats like doc, pdf, Image, and video. The frame or the images are extracted on which a pre-trained YOLO model performs the computation in detection and services like zxing, pyzbar, open cv, and PIL. The extracted, cropped, and detected images are stored in a bucket of cloud that can be used further to retrain the model and update it.

This paper has been divided into seven sections. The first section is the literature review of the research papers being published, section two contains the model architecture knowledge and its training, the third section has doc conversion to Image, the fourth section is cropping and saving, the fifth section is decoding, and the sixth section is the process flow, and last seventh section contains results and conclusion

1 Literature Review

As retrieving documents from the cloud is already quite a task, detecting and decoding the QR codes add labour to the process. This section includes the literature review on the state of art baseline models and reviews their performance. The Darknet is a kind of neural network that is being used for YOLO detecting objects, and the model is trained according to the data in which various data labelling tools for object detection are being used

Also, the structure of the model will give a pixel point or scale where the QR code is detected. After it, the inference is made with rectangle construction [7].

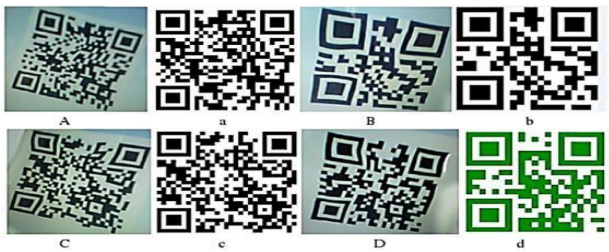

Figure-1 QR code structure

Table 1 Comparison Table of the baseline model Tab.1

	Sample processing	Readable	Cannot read	Literac Rate(%)	yIncreased Literacy Rate (%)
Direct Reading	300	209	91	69.7	0
Proposed algorithm processing	300	251	49	83.7	14

From the above comparison figure table, it is noted that the previous papers have a quality enhancement technique and are 83.7% accurate. The direct reading is the manual result of the users for which the QR code was actually readable; with this, we have the following comparison values. [9-10] The image quality and manual readability check are done for comparison. It is stated that the labelling of a QR code needs to be aligned with the service to reach a lossless imputation. In various papers, there were no detection measures mentioned.

The proposed research questions for this study are listed below.

RQ1 How can we train a document's model that detects QR codes?

RQ2. Which object detection approach is good?

RQ3.How can the accuracy metrics be formed for an object detection case?

2 Algorithm Structure

The algorithm proposed in this paper is structured in four steps. These steps have been discussed in detail.

2.1 Algorithm steps-

2.1.1 Data-Preparation and Training

The data have been created across 5k images across all documents. The model was fed with input data of images extracted from pdf with ground-truth, The ground-truth in this method was a bounded box around the QR code. The bounded box [11-14] is given as a pixel points file where the model can fetch the points and learn how to predict the inference time. The bounding box is prepared by a very user-friendly tool named as label box. Here is a flow of data labeling to training.

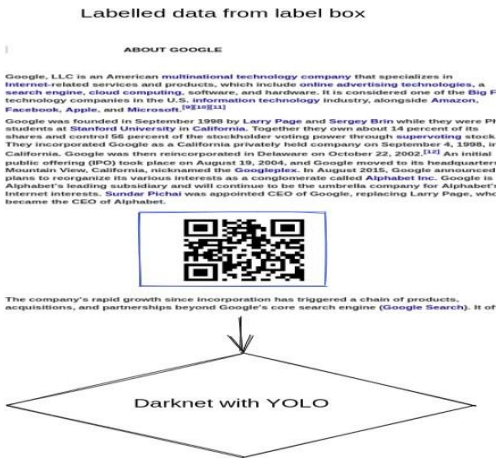

Fig-2 label and feeding to network

In figure-2, we have fed the document with a bounding box across the QR code and processed its pixel points so that model should know the ground truth. This document is fed as an image to the Darknet, and with the help of YOLO, we can find the QR code.

2.1.2 Pretrained model's inference

Now, as we have trained a model, we want to infer it by passing a document and analyzing its results. When we pass this testing document, it will crop and save the QR code. This is the exact functionality required to detect QR codes in a document.

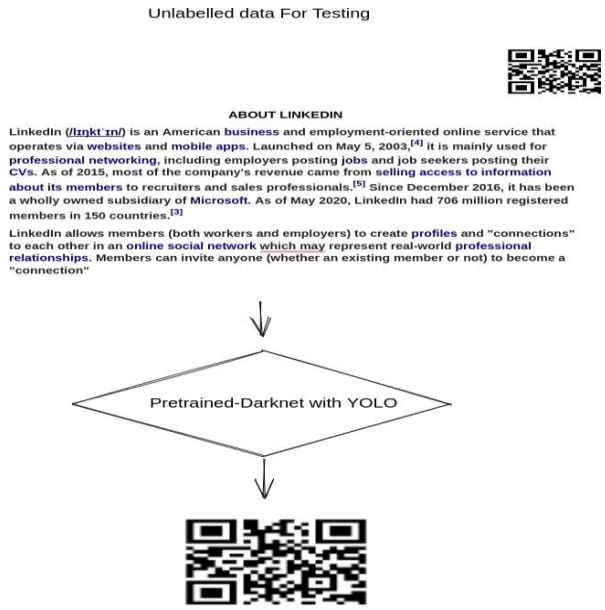

Fig-3 Testing a document on a pre-trained model

In Fig. 3, mainly unseen data not labelled in the training as we see the bounding box, are not present because we are making an inference. It cannot be done over a seen document as our precision, recall, and F1 will not matter. The data needs to be unseen for testing. Now we give the unseen document in the network, which is trained, and it predicted/detected the QR code and cropped it.

2.1.3 Image quality enhancement

The Image cropped and saved by our trained model needs a quality filter of GAN (Generative adversarial network). It will enhance the quality of the Image. [15-17] The main use is a lossless conversion. Data quality can never be compromised in a QR code case as it will never be scanned. So, we must pass the QR code to an image quality enhancement. The output from GAN will take care of blurriness and bad quality to the best quality image.

Here is an example where GAN is widely used, which is to retrieve [18] a better-quality image from blurred and noisy images [19-20]

Fig-4 GAN Used to fetch better quality images

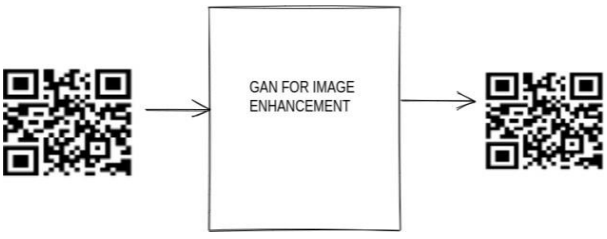

Fig-5 Passing Detected QR Code to GAN

2.1.4 **QR code Decoding**

Here many scanners supported in python are

used as an ensemble method. The idea is derived from the bagging method, where we take multiple predictions and select the prediction with the maximum vote. But in this, we will pass the QR code cropped and enhanced to the scanners and select the common result. The issue with scanners is that one can scan a QR code that is not scanned by others. This problem was addressed in an ensemble way where all scanners will scan if one fails, then the other will help

Here is the list of scanners available

- Pyzbar
- Zxing
- Wand

Here is the decoding flow:

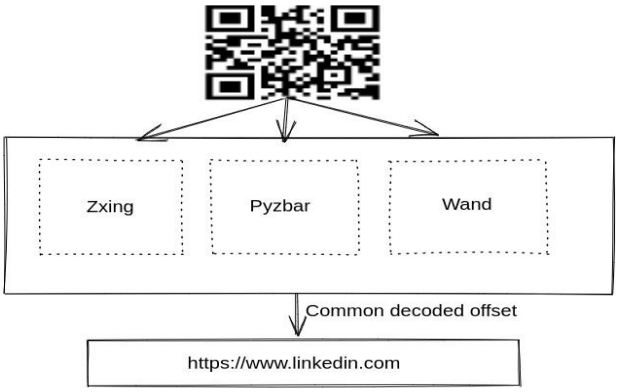

Fig-6 Decoded QR code

3 Process Flow

Here in Figure 7, the complete flow diagram for allsteps is presented.

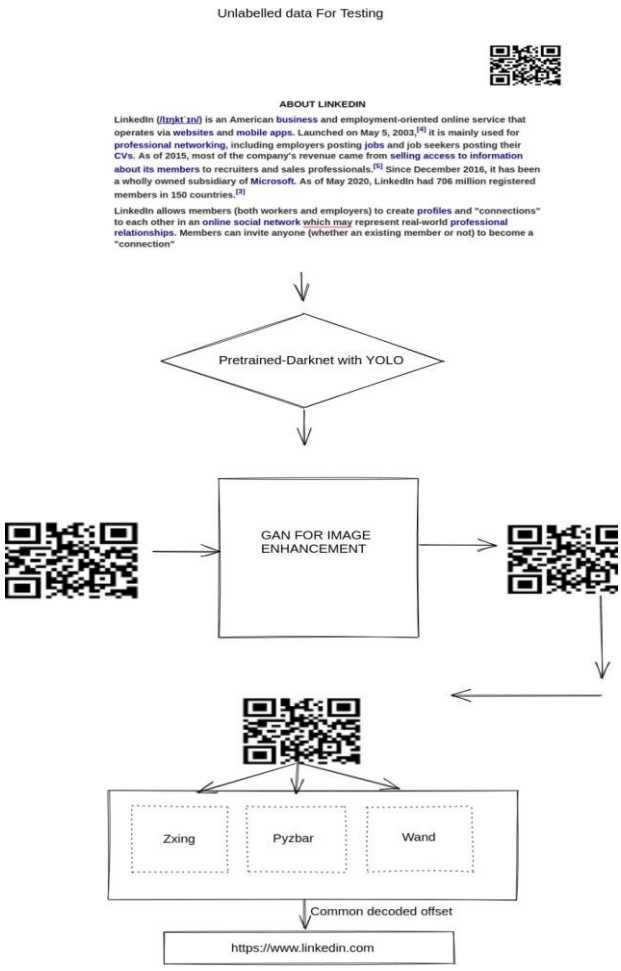

Fig-7 Process Flow

4 Results and Discussion

Here 10 sample pdfs results are shown, and the final comparison graph with baseline models is done with 500 pdfs. As we got 90% accuracy in these ten pdfs. But with 1k pdfs, we got 89% accuracy.

S. No	No of pages	No of QR code pages	Readable QR code	LO+GAN+Enemble _Scanner
Sample- 1.pdf	4	2	2	2
Sample-2.pdf	4	2	2	2
Sample-3.pdf	2	2	2	1
Sample-4.pdf	3	2	2	2
Sample-5.pdf	1	1	1	1
Sample-6.pdf	3	3	3	3
Sample-7.pdf	4	2	2	2
Sample-8.pdf	7	4	4	3
Sample-9.pdf	1	1	1	1
Sample-10.pdf	2	1	1	1
Total	**31**	**20**	**20**	**18**

Table 2 Results of ten sample pdfTab.2

5 Comparison Visualization

Figure 8 presents a visualization comparison report forthe baseline model and YOLO.

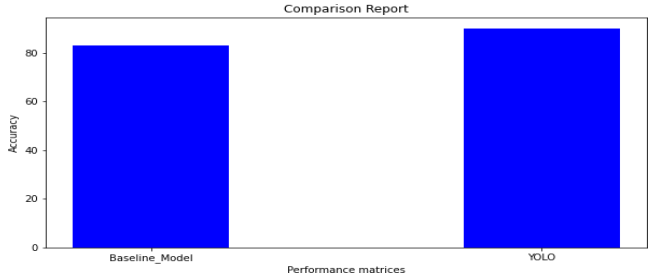

Fig-8 Comparison Report

6 Conclusion

This paper's fundamental objective is public cloud information assurance utilizing the Utilizing QR Code Recognition and Translating utilizing Darknet and YOLO. The Darknet does the primary idea of this procedure; Consequences be damned and QR Code. After transferring the information, it may be very well to any place and at whatever point required. If the QR code is identified through physical work, it will be tedious and require endeavour. In this method, QR codes are identified and decoded utilizing Darknet. Consequences are damned while keeping the information on the cloud.

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