QR Code Generator and Detector using Python

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Abstract- QR codes were developed in the 1990s as a way to provide more information than a standard barcode. QR code was invented by a Japanese engineer Masahiro Hara from automobile manufacturer Denso Wave in the year 1994 to track the movement of car parts. QR codes consist of black squares arranged in a grid (matrix) on a white background and are read by specialized software that is able to extract data from the patterns that are present in the matrix. These codes are capable of containing more information than traditional barcodes, and primarily handle four modes of data: alphanumeric, numeric, binary, and Kanji. QR code means Quick Response Code. Now a days it is used widely in many organizations. QR codes are frequently used to track information about products in a supply chain. QR Code has increased in popularity in the later 2010s with improvement in optical capabilities of mobile phones and their wide adoption.Nowadays, QR codes are being used for wide variety of applications like, make online payments, check hotel menu, share wifi password, obtain price and other details of products etc. QR Codes have become so popular that now every new smartphone comes within built QR code reader.

Keywords— Android Operating System, Mobile Network Operators, Mobile Application Scanner, Quick Response Code (QR), Python Flask Framework, Recharge Vouchers, Smart Phone.

I. INTRODUCTION

A Quick Response Code or a QR Code is a two dimensional bar code consisting of grid of tiny black squares on a white background. Due to its ability to store more information and fast readability, it gained popularity over the traditional bar codes composed of black bars and white spaces.These read by specialized software that is able to extract data from the patterns that are present in the matrix. These codes are capable of containing more information than traditional barcodes, and primarily handle four modes of data: alphanumeric, numeric, binary, and Kanji. An enhancement on traditional barcodes, QR codes can store vastly more information and are used in a variety of applications from supply chain management to cryptocurrency wallet addresses. Several versions and variations of QR codes now exist that are customized to different purposes, or which can store greater amounts of data. There are different versions are there in qr code. The symbol versions of QR Code range from Version 1 to Version 40. Each version has a different module configuration or number of modules. The module refers to the black and white dots that make up QR Code.)

"Module configuration" refers to the number of modules contained in a symbol, commencing with Version 1 (21 × 21 modules) up to Version 40 (177 × 177 modules). As version increases number of modules in a QR code also increases which can store more data. The QR Code is the trademark for a type of matrix barcode (two-dimensional barcode) first designed by the automotive industry in Japan. Also, a barcode is a machine-readable optical label that contains information about the item to which it is attached. A QR code uses four standardized encoding modes (numeric, alphanumeric, byte/binary, and kanji) to efficiently store data; extensions may also be used. It has a larger set of machine readable codes as compared to the one-dimensional barcode and it can hold more data because it uses both the horizontal and vertical axis. It is widely used in different fields such as manufacturing and mobile marketing. QR codes have a more advanced error correction mechanism and are more reliable as it has a faster speed than other codes (Adeel et al., 2014). Below is a sample of a QR Code. They were first created in 1994, its purpose was to track vehicles during manufacturing; it was also designed to allow high-speed component scanning. In 2002, when Japanese handset makers and others wanted to turn everyone's phone camera into a barcode scanner for marketing purposes, QR codes were very handy. With two dimensions of operation, QR codes are able to store several hundred times the amount of information carried by ordinary bar codes. They can contain anything that can fit into a maximum of about 4k (roughly one page of text). These codes are versatile. Application of QR Codes include their use on newspapers, magazines, journals, websites, advertisement, and advertisement board, where they are depleted to store websites' addresses, content information and miscellaneous data. Also, the QR Code is used in advertisements to guide people to visit their websites in the business world. Additionally, the QR Code becomes an official tool that is utilized in governments and companies. In 2011, the Royal Dutch Mint announced that QR Code which will be embedded into the official coin would direct a user to a website about the Royal Mint's centennial.

The world's largest QR Code is created by Hacherspace and painted on the top of their company's building in Charlotte, North Carolina in (2010). In China, the QR Code is used on the train tickets on the corner of the right bottom and the names of passengers and relevant personal information are also included in this QR Code (Ahamad S. S. et al., 2014). Several pricing models have been postulated for services provided by MNOs. These include Pre-pay and Post-pay Pricing Model, Smart Data Pricing (SDP) model, Bundling Strategy based SDP, Micro-billing framework, Sealed-bid auction-based pricing, Sealed-bid reverse auction-based pricing, Cost-based pricing, Stackelberg game-based pricing, metered charging, Hybrid pricing model, Pay-asyou-go, Post-Paid and Pre-Paid. However, the most frequently used pricing model used in Nigeria is the prepaid and post-paid pricing models. For any of these pricing models, an exchange of cash for intended services is expected (Lu et al., 2017). Post-paid pricing model is an account-based model where subscribers are expected to deposit any amount into the MNOs bank account. However, with the pre-paid option, subscribers are expected to acquire the respective MNOs recharge vouchers. After acquisition, subscribers are expected to scratch the vouchers for the recharge codes to be revealed (Susono and Shimomura, 2006). The revealed recharge codes are then subsequently entered into the subscribers' mobile devices. A lot of time is consumed in this process which is prone to error as the recharge code may have up to a sequence of sixteen numbers. Repeatedly entering wrong recharge pins three times may lead to the blockage of individual's mobile line. Furthermore, the scratched recharge pins must be entered in a MNOs specified format. For instance, MTN Nigeria communications expects her subscribers to use *555*recharge_code# for their payment while GLO expects a subscriber to use *123*recharge_code#. Airtel expects a subscriber to use *126*recharge_code# while EMTS expects *222*recharge_code# to be used by a subscriber (Frank et al., 2011). As simple as these steps seem to be, not all subscribers can accurately employ the payment method which has led to errors and subsequent forfeiture of the acquired recharge pins as the case may be. The objective of this study is to use a Python Flask Programming language in designing the QR Code mobile network operating recharge system, that is, a mobile application that can read, decode and upload the mobile network operator (MNOs) recharge code. The development and use of QR codes was catalyzed by the need to speed up the transaction process by reducing the number of user inputs when recharging with any of the mobile network services like MTN.

II. RELATEDWORKS

In existing system QR code is simple and is used in areas of for tracking labeled industrial and commercial products, advertising and marketing, sale of goods, identification of business cards, bank accounts, immigration stamps, in general in many situations, where sharing of information about any object is required. The object information or details are encoded in QR code.

In existing system the QR code is version 1 QR code, which consisting of only 21 module. The module refer to the white and black dots that make up QR code. QR code symbol version 1 has minimum data capacity according to the amount of data, character type and error correction level. In other words, as the amount of data increases. More modules are required. So version 1 QR code is not supported for large data. Along with this, security is one of the drawback

III. PROPOSED SYSTEM ARCHITECTURE

To overcome the problems faced in the existing system, we proposed a new system ie advance QR code which can create a QR code for larger data. This system can create QR of different versions. The amount of data that can be stored in the QR code symbol depends on the datatype (*mode*, or input character set), version (1, ..., 40, indicating the overall dimensions of the symbol, i.e. 4 × version number + 17 dots on each side), and error correction level. The maximum storage capacities occur for version 40 and error correction level L (low), denoted by 40-L. Python Flask Framework: Flask is a micro web framework written in Python. It is classified as a micro framework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. It provides the user with libraries, modules and tools to help build WebApplications such as a blog or wiki. The unit testing of the developed mobile network recharge voucher application was carried out using Python flask frame work. Python flask is a unit testing framework that provides a Java Virtual Machine (JVM) compliant version of the Android Mobile Scanner App. This permits developers to write codes to test each units of their android application and run them on android studio MVC IDE while still using the Android Application Program Interface (API). Python flask is an interpreter, high-level, general-purpose dynamic programming language used for everything, from server automation to data science. It is an open-source software. Python is a great language for beginners, because it is easy to read and understand. You can also do so many things with Python flask that makes it easier to stick with the

language for quite a while before needing something else. Python finds itself at home when creating Web Apps like Instagram and helping researchers make sense of their data (Susono, et al, 2006). The syntax in python helps the programmers to do coding in fewer steps as compared to java or C++. Debugging can be done easily with this language too. Python also processes XML and other markup languages as it can run on all modern operating systems through same byte code. The programming language used in this project is Python Flask Programming. We also made use of HTML, CSS, Bootstrap, and Java Script, and we made use of the Notepad ++ 6.7 as the code editing environment (Sowern, 2011). Additionally, C-Sharp Programming Language was used. The C# is a hybrid of C and C++, it is a Microsoft programming language developed to compete with Sun's Java language. C# is an objectoriented programming language used with XML-based Web services on the .NET platform and designed for improving productivity in the development of Web applications.

Maximum character storage capacity (40-L)

character refers to individual values of the input mode/datatype

Input mode	Max. characters	Bits/char.	Possible characters, default encoding
Numeric only	7,089	$3\frac{1}{3}$	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Alphanumeric	4,296	$5\frac{1}{2}$	0–9, A–Z (upper-case only), space, $, %, *, +, -, ., /, :
Binary/byte	2,953	8	ISO 8859-1
Kanji/kana	1,817	13	Shift JIS X 0208

Fig.1 Proposed System Architecture

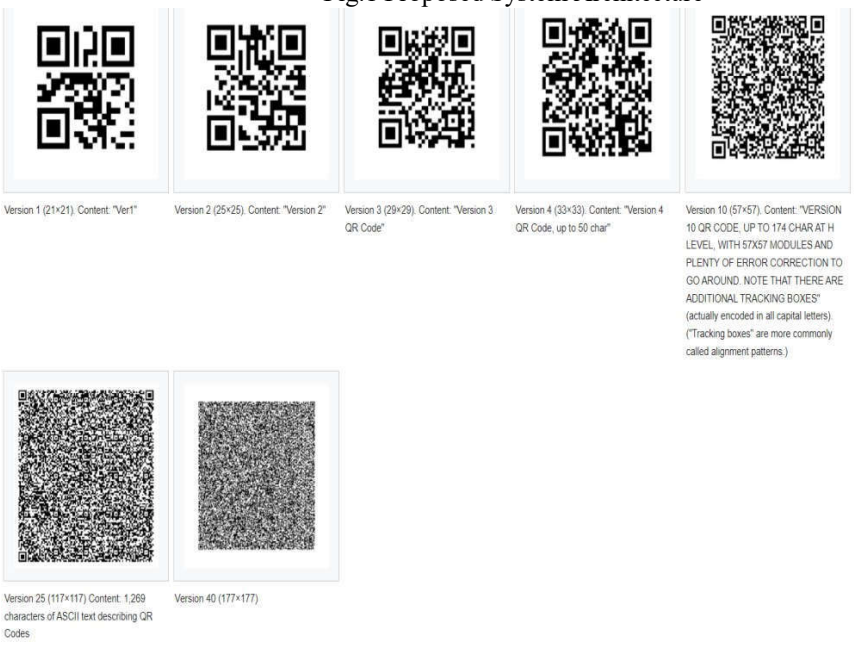

Fig.2 Different QR codes

Two-dimensional (2D) matrix codes are a way how to efficiently store data that are machine readable. Thanks to the great spread of smartphones, 2D matrix codes have found application in many areas of life and industry. QR (quick response) Code was invented in 1994 by Denso Wave for the automotive industry in Japan, but nowadays has much wider usage. They are widely used in segments such as manufacturing, logistics, sales, media, advertising, tourism, e-commerce, identification, and authentication [1,2]. The QR Code often contains additional information about the product, the object or the place where it is located. However, they can also be a URL to a web page, Global Positioning System (GPS) coordinates, contact details, delivery address, payment instructions, etc. QR codes belong to a group of 2D matrix codes (similarly the data matrix codes). Traditional QR code (QR code Model 1 and Model 2) has a square shape and on its three corners are typical square-shaped patterns—finder patterns (FP), which are used to locate the code and to determine its dimensions and rotation.

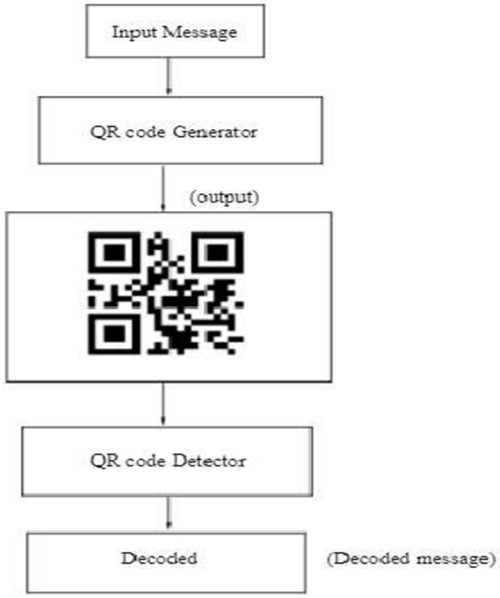

Fig.3 Block diagram of proposed system

IV. RESULTS AND DISCUSSION

In Generator module, we import predefined module qrcode. Generator module receives the input from the main module and generate the QR code, It store the generated QR code in hard disk in .png format.

qrcode_module:

qrcode module is used to make qrcode by using predefined function "qrcode.QRCode()".

This function has 4 parameters:

- Version
- Error_correction
- box_size
- border

Version: The version parameter is an integer from 1 to 40 that controls the size of the QR Code (the smallest, version 1, is a 21x21 matrix). Set to None and use to fit parameter when making the code to determine this automatically.

Error_correction: The error_correction parameter controls the error correction used for the QR Code. The following four constants are made available on the qrcode package:

- **ERROR_CORRECT_L**: About 7% or less errors can be corrected.
- **ERROR_CORRECT_M**: About 15% or less errors can be corrected. (Default)
- **ERROR_CORRECT_Q:** About 25% or less errors can be corrected.
- **ERROR_CORRECT_H:** About 30% or less errors can be corrected.

Box_size: The box_size parameter controls how many pixels each "box" of the QR code is.

Border: The border parameter controls how many boxes thick the border should be (the default is 4, which is the minimum according to the specs).

- The QRCode object has the following functions which can be used to create the QR Code.

i. add data

The content of the QR code can be passed as an argument to this function.

ii. make

If you are not sure about which version of QR code to use, the version can be set automatically by:

a. setting *version* parameter to *None* and

b. seting *fit* parameter of *make* to *True.*

iii. make image

This function generates the QR code. It can also be used to set the fill color and background color of the QR code using *fill_color* and *back_color* arguments. In Detector module, we import predefined module cv2.

detector module receives the input of .png formatted QR code from main module, decode the QR code and prints the data. Detect and decode is used to detectect in img which contaion Qrcode

Syntax:

retval, points, straight_qrcode=cv.QRCodeDetector.detectAndDecode(img[, points[, straight_qrcode]])

Parameters:

img	grayscale or color (BGR) image containing QR code.
points	optional output array of vertices of the found QR code quadrangle. Will be empty if not found.
straight_qrcode	The optional output image containing rectified and binarized QR code

V. FUTURE SCOPE AND CONCLUSION

"Quick Response" (QR code) is a matrix code. As compared to one dimensional barcodes it must store huge volume of information and using any handheld devices like Smartphones it must be decrypted at high speed. These two points are taken into consideration while designing two dimensional matrix codes. When a bar-code contains vital information or privacy information, the chance of security becomes a very important aspect. Because QR codes merely feature a square bar-code with a distinctive pattern, individuals are not aware if the code can take them to respectable information or misguide them to a website loaded with malware. Now of late, a QR code is applied in several application streams associated with promoting, security, lecturers etc. and gain popularity at a really high pace. Gradually more people are getting familiar with this technology and use it accordingly. The popularity of QR code grows swiftly with the growth of smartphone users and thus the QR code is briskly arriving at high levels of acceptance worldwide. With the wide implementation of QR code, the protection feature of QR code is serious, like data leakage and data alteration. This paper emphasizes on the analysis of QR code and its applications.This platform could be used by different security conscience organizations. Text files or password system could be encrypted into QR Code and be read by a mobile device, etc. The work is achieved by the use of python flask framework which is the main interface for generating the QR Codes. The system will have a login access point to prevent unauthorized user to have access to the QR code generating session. They generate QR Code one after the other in other to store the encrypted string into Sqlite Database Models. On the other hand, a mobile QR code scanner makes it easier to use mobile application to identify the encrypted code. This work has introduced a Quick Response (QR) Code generator with Mobile Scan Application for Mobile Network Recharge Operations. It has successfully demonstrated how QR codes can be used to secure Mobile Network recharge vouchers with a view to prevent unauthorized access to recharge pins that has characterized the existing recharge voucher patterns. The standalone software application developed was used to generate the QR code while the mobile application introduced was used to read the recharge code information embedded in form of QR code. The advent of smartphones with powerful features like mega pixel camera has also made the QR code scanning process easier contributing to its wide usage and acceptability. This has shown that QR code can find practical applications in mobile network recharge operation services This system as it is based on MTN network can only generate N100, N200, N400, QR recharge code. However, the software application can be improved upon to generate N750, N1500, etc recharge coupons as well as other coupons for other mobile networks, like globacom, 9mobile, etc.

We have proposed and tested a precise and fast method for the location of perspective-distorted 2D QR Codes in arbitrary images under various lighting conditions. This method is suitable for localization of single or multiple QR Codes in low-resolution images as well as for real time processing. The proposed methods use typical position detection patterns of QR Codes so-called finder patterns to identify three corners of QR Codes in an image. For distorted QR Codes perspective transformation must be set-up. The optimal position of the fourth corner of the QR Code is determined by analyzing the direction of horizontal and vertical edges and by maximizing the standard deviation of horizontal and vertical projections of these edges. Prerequisites of our method are the existence of intact finder patterns and quiet zones around a QR Code. The novelty of our method lies in the way the bounding box of a QR Code is determined, especially for perspective-distorted QR Codes and how variable-sized modules are handled. This method was validated on the testing set consisting of synthetic and also real world samples and it was compared with competitive solutions. The experimental results show that our method has a great detection rate. Unlike other articles, we consider a QR Code to be successfully recognized only if it is also decoded, not just localized. Precise localization is a necessary but not sufficient condition for successful decoding.

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