

Real-Time QR Code Detection, Decoding, and Processing with URL Extraction

Rostata - Malveda



QR Code
Detection

Group Members



← → Q Q DSPML.com

Developers



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Introduction

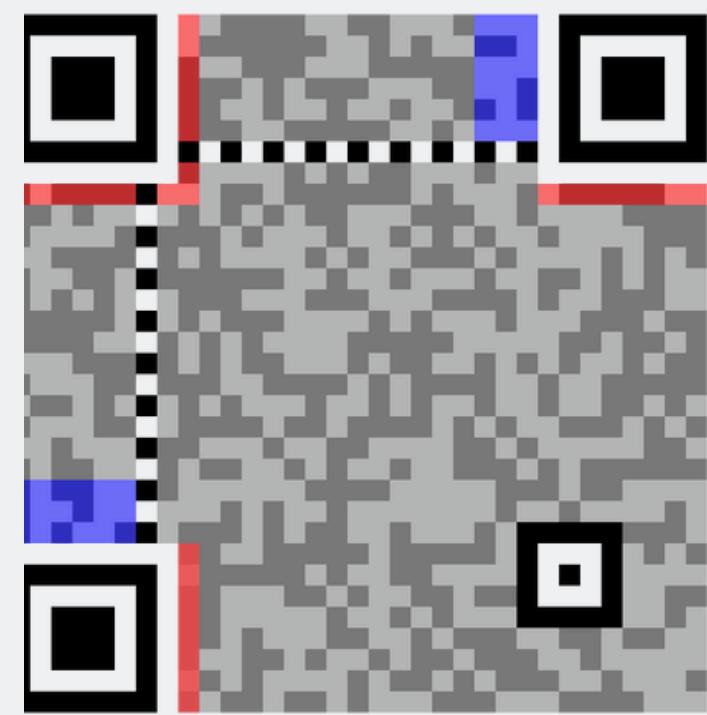


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Introduction

QR Codes:

- Definition: Image and information encryption/decryption.
- Advantages: Fast readability, ample storage.
- Features: Position detection patterns, error correction (Mehta, 2021).



- 1. Version Information
- 2. Format Information
- 3. Data and Error Correction Keys
- 4. Required Patterns:
 - 4.1. Position
 - 4.2. Alignment
 - 4.3. Timing



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Introduction

Alpha Blending:

- Importance: Key in image processing.
- Objective: Integrate light/transmittance matrices while preserving image edges.
- Method: Foreground overlays background seamlessly (GeeksforGeeks, 2021; Lian, 2023).

Decoding QR Codes:

- Process:
 - Analyze edge directions for distortion.
 - Algorithms: Pattern recognition, error correction, data extraction (Karrach, 2020).



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Objectives

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Objectives

The specific objectives of the project are:

- To develop a program that can detect and decode QR codes from real-time video capture source
- To process decoded QR code data to extract information (e.g. Text, URL)
- To develop a functionality to extract URLs from decoded QR codes and redirect users to the web.
- To implement Alpha blending and Pyzbar decoding in real-time video processing.



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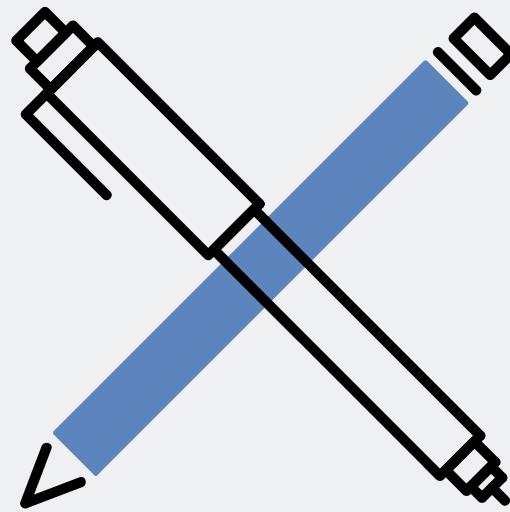
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Practical Application X +

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Practical Application

Versatile tools optimizing information dissemination and transactional efficiency across diverse areas.

- Retail Sector
- Connectivity
- Education
- Financial Transactions

Methodology

Frame Preprocessing

Preprocessing Pipeline for QR Code Detection:

- **Grayscale Conversion:**
 - Utilized cv2.cvtColor() function.
 - Transformed RGB color space into single-channel grayscale.
 - Purpose: Reduce computational overhead, enhance QR code visibility by eliminating color variations.
- **Gaussian Blurring:**
 - Applied to grayscale frames using cv2.GaussianBlur() function.
 - Objective: Reduce image noise, enhance clarity of QR code structures.

```
def preprocess_frame(frame):
    # Convert frame to grayscale
    # We used cv2.COLOR to perform a conversion of the frame from BRG to gray (same with colors' rgb2gray function)
    # This is to simplify the QR code image/frame to reduce processing task
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # Apply Gaussian blur for noise reduction
    blurred = cv2.GaussianBlur(gray, (5, 5), 0)

    return blurred
```



Gray Image



Gray image with Gaussian Blur



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QR Code Detection and Decoding

- Utilization of pyzbar Library:
 - Python interface for ZBar library, renowned for barcode and QR code reading.
- Core Component: decode() Function:
 - Purpose: Decoding barcode and QR code data from images.
 - Algorithms:
 - QR Code Detection Algorithm:
 - Techniques: Image scanning, pattern recognition.
 - Detects distinctive features indicative of QR codes, enabling accurate localization within the image.
 - Decoding Algorithm:
 - Extracts encoded data from detected QR code.
 - Process: Interprets arrangement of black and white modules, adheres to QR code standard for accurate data retrieval.
 - Data Representation:
 - Returned decoded objects encapsulate:
 - Decoded data content.
 - Data type (e.g., text, URL).
 - Positional information for subsequent processing and utilization.



Gray image with Gaussian Blur



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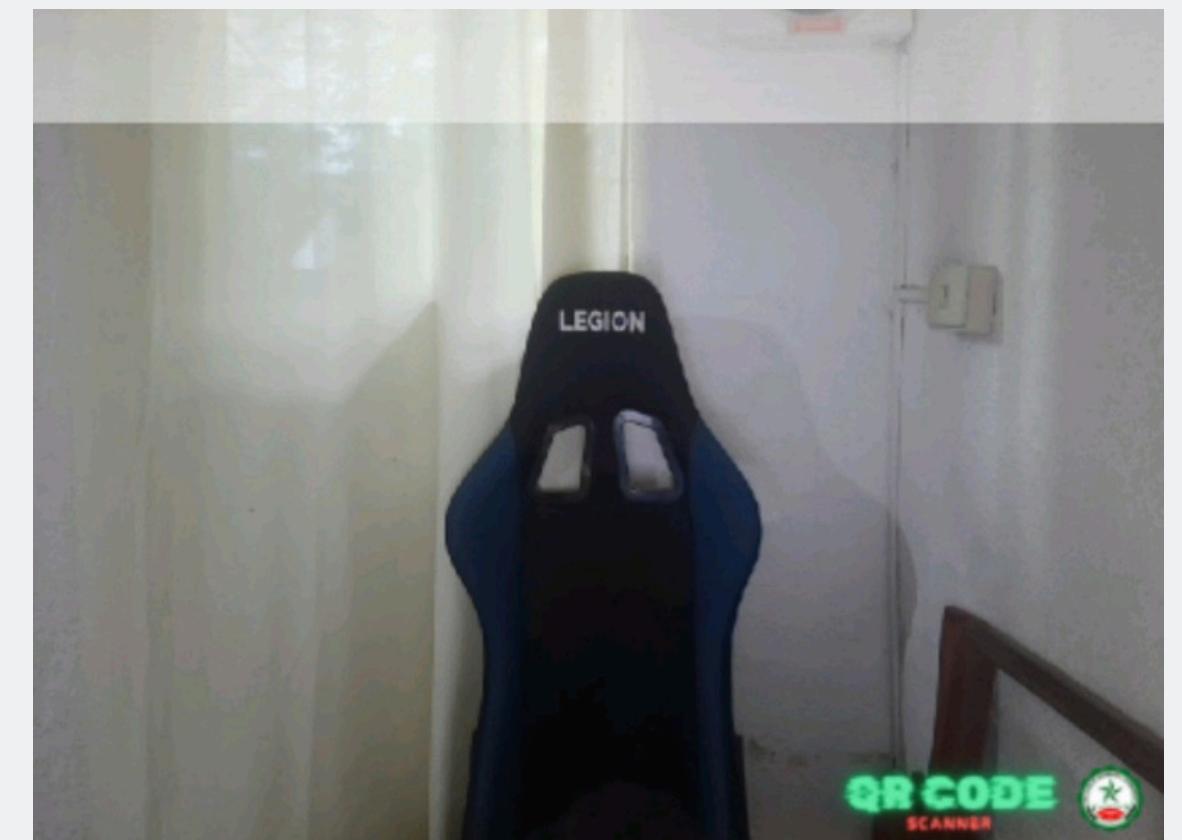
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Alpha Blending

- Alpha blending used for overlaying watermark onto video frames
- Technique combines pixel values of watermark with underlying video frames
- Incorporates transparency factor (alpha channel) to control blending degree
- Implemented using OpenCV
- Seamless integration of watermark onto video frames while preserving transparency

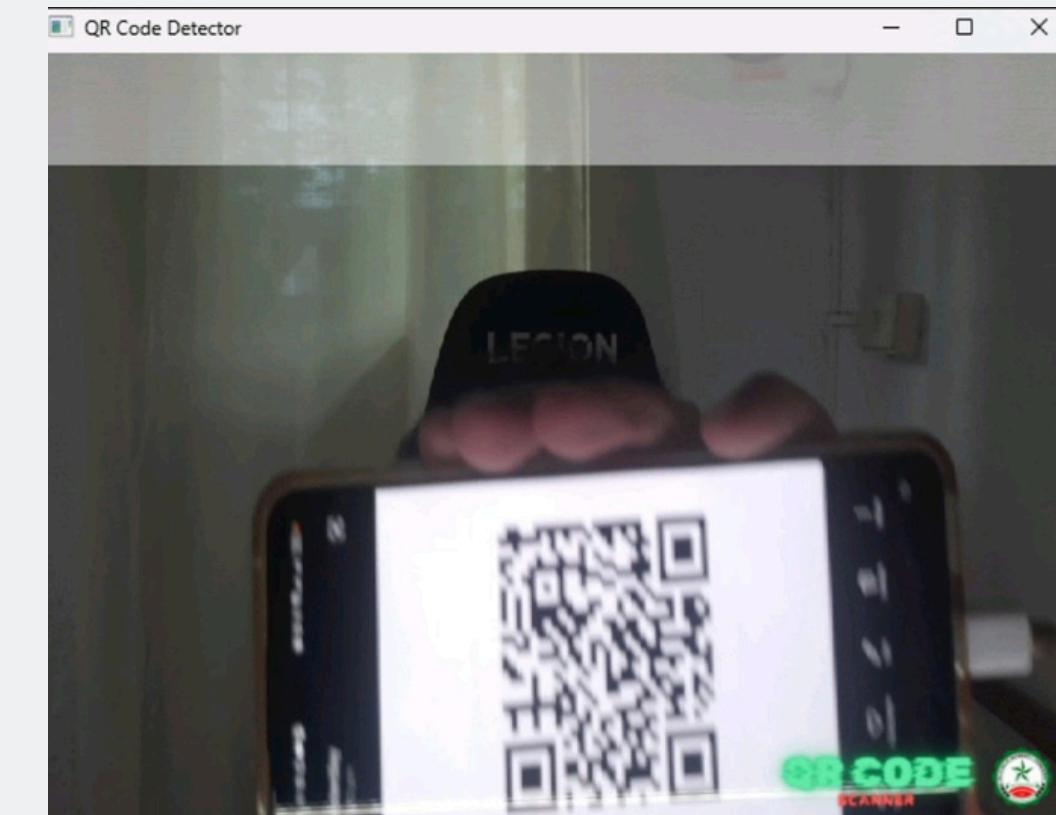
```
# Watermark using Alpha Blending technique
scan_height, scan_width, _ = scan_image.shape
    # we retrieved the image dimensions using the shape attribute and stored them inside separate variables
start_x = int((frame.shape[1] - scan_width) / 2)
start_y = int((frame.shape[0] - scan_height) / 2)
    # This lines computes the starting coordinates of the mask to ensure that it is centered within the set webcam frame
mask = scan_image[:, :, 3] / 255.0
    # Here we are extracting the alpha channel of the scan_image to determine the transparency of each pixel.
for c in range(3):
    frame[start_y:start_y + scan_height, start_x:start_x + scan_width, c] = \
        scan_image[:, :, c] * mask + frame[start_y:start_y + scan_height, start_x:start_x + scan_width, c] * (
            1 - mask)
    # This code applies the mask onto the frame using alpha blending.
    # This iterates over each color channel RGB of the frame
    # It basically calculates the blended pixel value based on the alpha mask and overlays the
    # watermark onto the frame.
```



Alpha Blending Applied in Video Frame

URL Extraction and Redirection

- QR code content extracted to identify embedded URLs
- Decoding process inspects data for "http://" or "https://" prefixes
- Users prompted to decide whether to access extracted links
- Utilization of `webbrowser.open()` function for URL redirection
- Redirection occurs upon user consent
- Facilitates direct access to online resources embedded in QR codes, enhancing user engagement



Video Frame when URL was scanned

```
#Extraction of URL and redirecting
# Check if decoded data is a URL, if it is, then a prompt will show up in the output Log
if QRcode_data.startswith("http://") or QRcode_data.startswith("https://"):
    response = input("Do you want to open this link? (y/n): ")
    # if the response is 'y', then the webbrowser.open() function will redirect the QR Code Link
    # to a tab in the browser. If 'n' then nothing happens, and the code proceeds to Loop.
    if response.lower() == 'y':
        webbrowser.open(QRcode_data)
```

```
[INFO] Found QRCode QR Code: https://dlsud.edu20.org/
Do you want to open this link? (y/n):
```

Program Prompt



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Analysis and Result

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ANALYSIS AND RESULT

- OpenCV efficiently detects single QR codes
- Pyzbar accurately decodes information from single QR codes
- Limitation: inability to simultaneously scan multiple QR codes
- OpenCV's capability extends beyond built-in camera to alternative sources like OBS
- Pyzbar decodes QR codes swiftly and accurately
- Integration of webbrowser module enhances user experience by redirecting users to decoded URLs, bridging QR code scanning and web interaction



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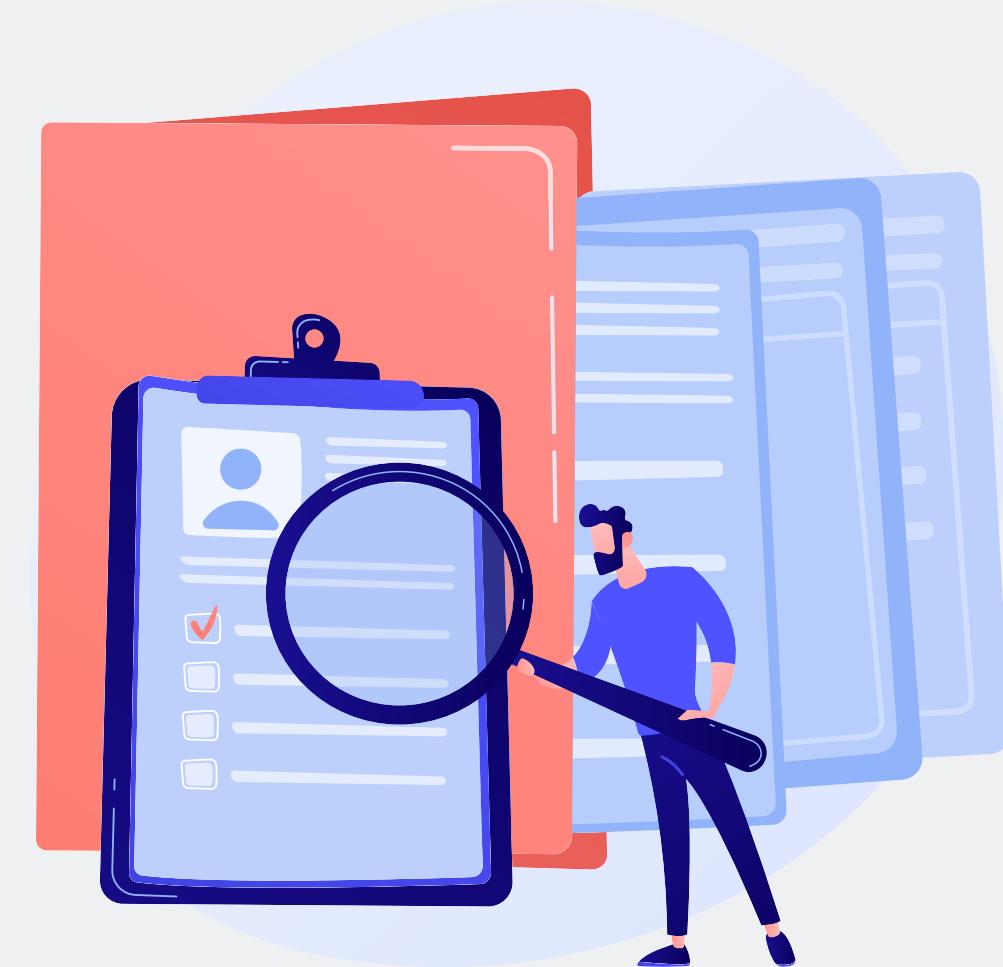
Analysis and Result

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Documentation and Report

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Limitations and Future
Work



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Limitations and Future Work

- Limitations
 - Inability to perform simultaneous tasks
 - Frame freezes when scanning QR codes containing URLs because the program waits for a response before proceeding with the loop
 - Reliance solely on laptop camera output may not always be practical
- Suggestions for Future Research
 - Integration of functionality into a microcontroller unit (MCU) for versatility
 - Enhancement of functionality to include scanning and displaying images on-screen
 - Implementation of diverse redirection techniques for enhanced security





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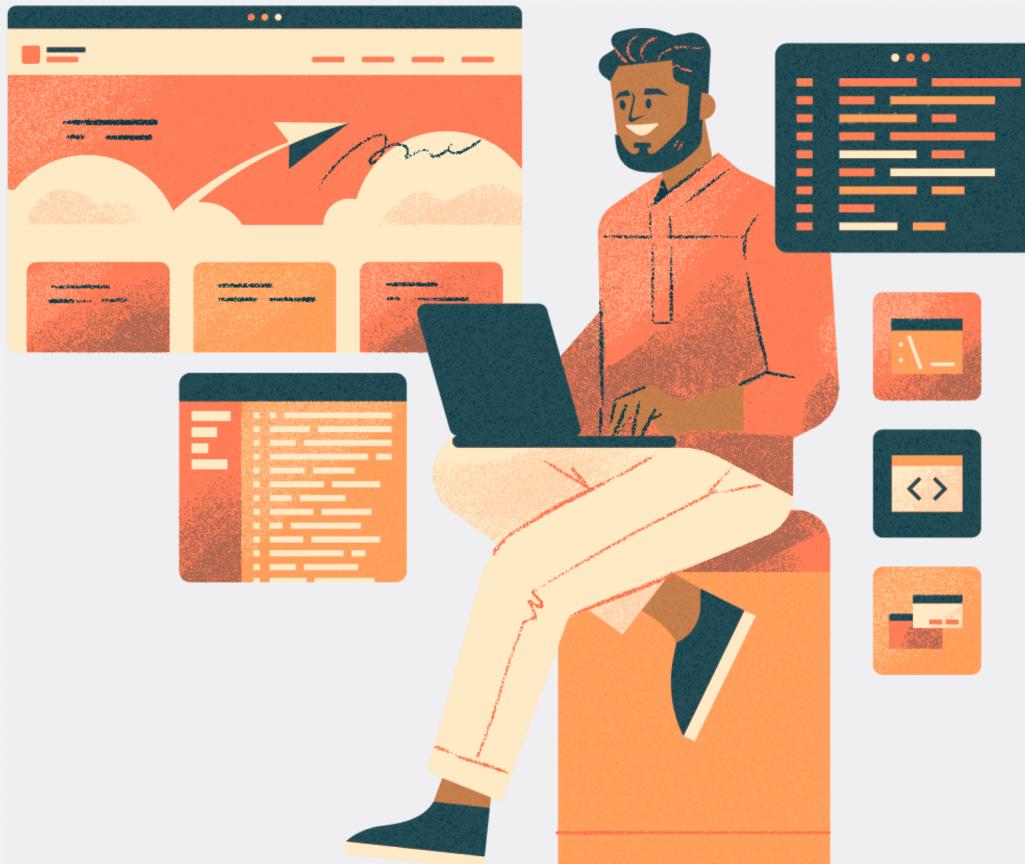
Limitations
and Future
Work

Conclusion

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Conclusion



- OpenCV and Pyzbar are the backbone of the developed QR code scanning program.
- Limitations include the inability to scan two QR codes simultaneously.
- QR code detection and decoding effectiveness maintained with open-source libraries.
- Image processing techniques like alpha blending in OpenCV and preprocessing methods enhance understanding and application.
- Comprehensive toolsets greatly improve QR code scanner efficacy.



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References



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References

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