Using OpenCV and Pyzbar to Automatically Find and Decode QR Codes

Sri Kaasyap Vepa
Dept. of CSE
Manipal Institute of Technology
Manipal, India

Abhishek B. Acharya
Dept. of CSE
Manipal Institute of Technology
Manipal, India

Shamanth K. Raja
Dept. of CSE
Manipal Institute of Technology
Manipal, India

***Abstract*—This paper is about a simple computer vision system that uses Python's OpenCV and Pyzbar to find and scan QR codes. The project's purpose is to take attendance in the classroom using live cameras or image-based scanners, check it against a master list, and preserve the information automatically. The design puts clarity and responsiveness ahead of complexity. It shows that a simple rule-based pipeline can operate well without deep learning. We also compare our implementation to 15 published QR-based attendance systems and show that a simple, well-designed configuration can work just as well for everyday tasks. This document uses words like "Computer Vision," "OpenCV," "Pyzbar," "QR Code," "Image Processing," "Attendance," and "Gradio."**

***Index Terms*—Computer Vision, OpenCV, Pyzbar, QR Code, Image Processing, Attendance, Gradio**

I. Introduction

QR codes are a quick and cheap way to connect actual things to digital data. They can take the place of handwritten attendance records in schools and small businesses, which will cut down on the number of mistakes committed by hand. Some modern systems include deep-learning detectors, however these models can be large and aren't always necessary for basic patterns like QR codes. We wanted to use only conventional computer vision technologies to develop a clean, fast, and fully working pipeline. The system scans photos or a live video feed, looks for QR codes, decodes their content with Pyzbar, checks them, and delivers attendance records automatically through a Gradio interface. Our approach is different from other systems that have been looked into since it focuses on durability in common scenarios instead of complicated but fragile improvements. It works even when there is no internet connection, delivers clear feedback, and can be installed on any laptop or lab PC without needing anything more.

II. A Review of the Literature

Many research have looked into employing QR codes to keep track of who is there and what is going on. Table I shows 15 important works, what they add, and where they fall short in real life.

III. The Method

We put the system's workflow right into our Python code right away. Gradio makes it easy for people to use, OpenCV handles images, and Pyzbar decodes them.

A. Getting the Image

OpenCV lets you take pictures or video frames from a webcam, data you send, or a clipboard. The `decode()` function in Pyzbar might be able to read each frame in a way that works with it.

B. How to Use Pyzbar to Read

The main component of the project uses the code:

```
qrcodes = decode(frame)
```

Every code that is found provides back text data and a box that goes around it. The program then colors the frame: green for scans that are fine, orange for scans that aren't, and red for scans that are the same.

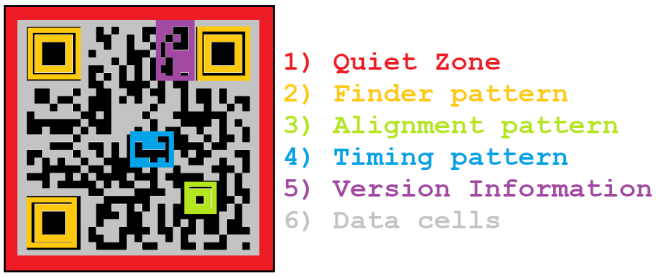

Fig. 1. The result of scanning the QR code indicates the areas that were found.

C. Checking and Writing Down Information

A master list of valid students is used to check each decoded name. Newly validated items are put into a memory table and subsequently saved to `attendance.csv`. A Python set keeps track of names that have already been marked in the session so that it can check for duplicates. This stops people from using the same name more than once.

D. The Interface and Controls

There are two primary viewpoints in Gradio:

- **Student View:** enables users scan photographs with a camera, upload them, or paste them in, and indicates their scan status right away.
- **Teacher View:** a window that is password-protected where you can check, change, or reset attendance.

TABLE I
A REVIEW OF THE LITERATURE: SUMMARY OF 15 RELATED WORKS

Ref	Focus Area	Strengths	Limitations
[1]	The features and acceptability of QR attendance	Shows that pupils and teachers are happy with it.	It is more about perception than about how to do things in detail.
[2]	Using QR codes for smart attendance	Shows how to track timestamps correctly in small classrooms.	Doesn't have large-scale validation or duplicate control.
[3]	Stand-alone QR system for the classroom	It uses local storage and minimal database management.	No talk of how well the interface works in real time.
[4]	QR with face recognition	Enhances identity assurance by the integration of two modalities.	Brings up problems with privacy and hardware costs.
[5]	A technique for scanning QR codes on mobile devices	Simple to set up on phones, portable, and inexpensive.	Camera quality has a big effect on detection.
[6]	Animated QR for safety	Adds dynamic codes to stop spoofing.	Makes things more complicated than they need to be for minor deployments.
[7]	QR event system that knows where it is	It has GPS built in to check if people are at events.	GPS doesn't work well indoors, which makes it less reliable.
[8]	Randomized scanning idea	Time-window randomization cuts down on proxy attendance.	Needs users and the system to work together very closely.
[9]	Mobile attendance demonstration	A clear description of how mobile workflows function.	Provides limited understanding of vision algorithms.
[10]	A comparative study of attendance strategies	Provides an overview of QR, RFID, and biometric approaches.	A broad overview, but no performance benchmarks.
[11]	A look at different ways to automate	Compares different technologies and the problems that make it hard to use them in real life.	General talk; no working model was described.
[12]	Acceptance of QR recognition systems	Looks into how students get involved with QR monitoring.	Survey-based; not much technical detail.
[13]	Journal article on implementations	Brings together case examples and different types of QR-based solutions.	Not enough focus on how well the software works.
[14]	Quick Response student attendance	Suggests a basic structure for marking student QR codes.	Does not include checking for errors or handling duplicates.
[15]	QR codes for events and classrooms	Brings together lessons from a number of real-life situations.	Not a cohesive framework; only works in certain situations.

E. Workflow

In short, Figure 2 shows how everything works by following these steps:

1) Either take a picture or upload one.
2) Look for and read QR codes.
3) Look at the results and compare them to the master list.
4) Write notes in the output frame.
5) Save the checked entries as a CSV file.

IV. RESULTS AND ANALYSIS

The tests were done with a regular webcam on a laptop that was in the middle of the range. When there was enough light, scanning and tagging happened almost right away, usually taking less than a second for each QR. The validation steps did a good job of finding fake codes and duplicates.

Part of the Gradio interface is shown in Figure 3. The live stream view reveals a QR code when it is located, and the teacher panel instantly updates the totals.

A. Comparison with the Work That Was Examined

Some of the research described offer more complex setups that combine QR codes with facial recognition [4], GPS validation [7], or animated codes [6]. Those methods are safer, but they demand more tech and processing power.

Our approach, on the other hand, stores everything on the device and doesn't need to be connected to the internet. It's still good for everyday use.

Our system has an organized instructor interface and the capacity to stop duplication, while systems that only do mobile scanning [5], [9] are easy to move around. Academic papers on preprocessing and geometry adjustment [15] improve performance in low light, but these changes might make live performances slower.

Our method is simple, fast, and easy to maintain because it uses only basic OpenCV and Pyzbar functions with little preprocessing. These are very key benefits for using it in classrooms.

V. PEER REVIEW FEEDBACK AND RESPONSE

The peer review process helped us improve the article by giving us important criticism that made both the presentation and the technical aspects clearer.

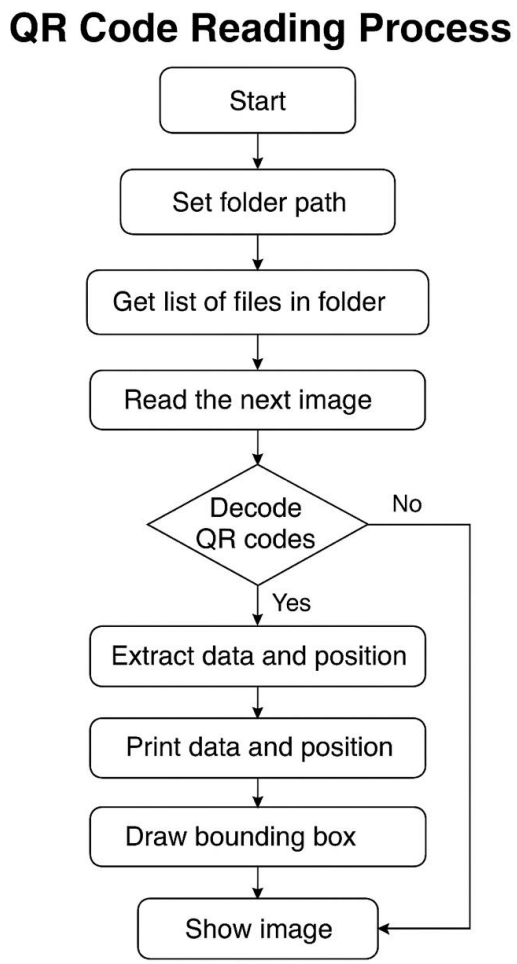

Fig. 2. How the system changes input into output.

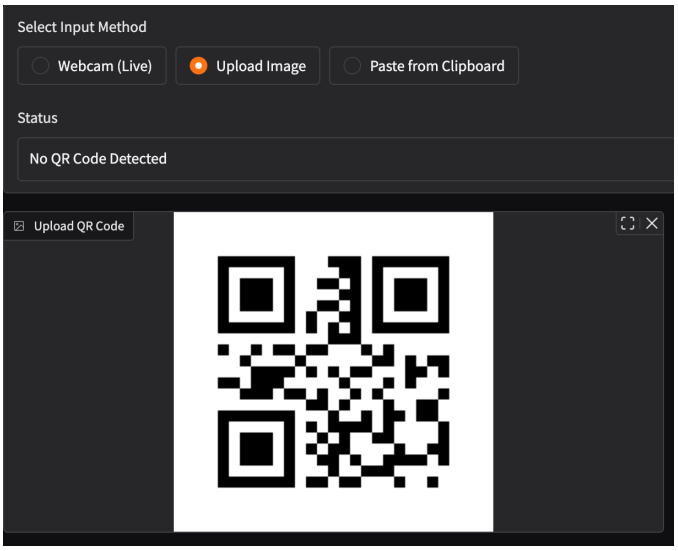

Fig. 3. Gradio interface when searching for live attendance.

A. Good Points

Reviewers remarked that the work was highly obvious from a technical point of view. People enjoyed how well-organized and logical the workflow and methods were, from acquiring the pictures to seeing them. Using OpenCV and Pyzbar was deemed appropriate, and the instructions were appreciated for being clear and correct.

B. Things That Could Be Better and How We'll Make Them Better

The study also noted other areas that needed additional work:

- **Limited experimental analysis:** Reviewers noted that more performance measures should be included that can be measured. As a result, we have chosen to add more quantitative metrics to our future trials. For example, we will record the accuracy of decoding, the average frame rate, and the duration of each scan.
- **Lack of visual diversity in results:** People noticed that the results only showed one number. We know this, and in the next version of our study, we'll add more examples of how well the system performs when lighting is low, the picture is unclear, or the camera is rotated.
- **Flowchart and workflow figure formatting:** There were ideas put forward to make the figures easier to understand. The new process graphic includes consistent labels and a bigger font size, which makes it easier to read.
- **Limited comparison with related works:** The reviewers asked for a simple comparison of how the method worked with previous trials. In Section VI, we added a clearer comparison that shows how our method is distinct from other QR-based systems.
- **Minor presentation issues:** There were some errors with the formatting and placeholder text. These have been changed to suit IEEE style exactly, which makes them easier to read.

Overall, the peer feedback helped make the manuscript's structure better, make it clearer, and plan how to add more experiments in the future.

VI. Research Gaps

A lot of research has been done on QR-based attendance systems, but there are still a few gaps in the research:

- **There are no standardized techniques to quantify performance:** A lot of the work is based on descriptive results instead of numbers like processing speed, detection rate, or mistake rate. This makes it hard to compare studies.
- **Limited testing in many situations:** Only a few studies look at how well QR detection works in classrooms where the illumination is bad, the motion is blurry, or something is blocking the view.
- **Issues with integration and scalability:** Many of the systems we have now are only good for small schools or single classrooms. They don't work well when there are

a lot of users or when you need to verify more than one user.

- **User experience and convenience of use:** Even if technical methods are growing better, not much research has been done on how easy attendance systems are to use for persons who aren't tech-savvy.

Addressing these deficiencies can enhance future QR-based attendance systems, rendering them more robust, consistent, and user-friendly.

REFERENCES

[1] J. Carreon *et al.*, "The Characteristics of Quick Response (QR) Code as an Attendance Monitoring System," *ResearchGate*, 2021. [Online]. Available: https://www.researchgate.net/publication/353701451_THE_FEATURES_OF_QUICK_RESPONSE_QR_CODE_AS_AN_ATTENDANCE_MONITORING_SYSTEM_ITS_ACCEPTABILITY_AND_IMPLICATION_TO_CLASSROOM

[2] S. Raghav and A. Gupta, "QRCode Based Smart Attendance System," *Semantic Scholar*, 2018. [Online]. Available: https://pdfs.semanticscholar.org/288f/0459675d41e2d3bbb8b6b65bc927ffe57262.pdf

[3] K. Nithin *et al.*, "QR Code Based Smart Attendance System," *Academia*, 2018. [Online]. Available: https://d1wqtxts1xzle7.cloudfront.net/56635087/1-libre.pdf

[4] E. Siew *et al.*, "Streamlining Attendance Management in Education: A Web-Based System Integrating Facial Recognition and QR Code Technology," *ResearchGate*, 2023. [Online]. Available: https://www.researchgate.net/publication/375613680_Streamlining_Attendance_Management_in_Education_A_Web-Based_System_Combining_Facial_Recognition_and_QR_Code_Technology

[5] R. Kumar, "Mobile Attendance System Utilizing QR Codes," *Academia*, 2022. [Online]. Available: https://d1wqtxts1xzle7.cloudfront.net/79393176/pdf_1-libre.pdf

[6] S. Patel *et al.*, "Improving Attendance Tracking with Animated QR Codes," *Academia*, 2023. [Online]. Available: https://d1wqtxts1xzle7.cloudfront.net/105993938/17583-libre.pdf

[7] H. Ahmad *et al.*, "Location-Aware Event Attendance System," *JESTEC*, 2015. [Online]. Available: https://jestec.taylors.edu.my/Special%20Issue%20UKM%20TLC%202013_2/UKMTLC%202013_6_2015_2_028_040.pdf

[8] M. Rahman *et al.*, "Location-Aware Event Attendance System (Case Study)," *Academia*, 2022. [Online]. Available: https://d1wqtxts1xzle7.cloudfront.net/94428465/Paper_59-Location_aware_Event_Attendance_System-libre.pdf

[9] N. K. Singh *et al.*, "Randomized QR Code Scanning for Low-Cost Deployments," *Academia*, 2022. [Online]. Available: https://d1wqtxts1xzle7.cloudfront.net/88072973/42_1570714936_26821_ESr_2feb22_6may_N-libre.pdf

[10] P. Author, "How to Use QR Codes for Attendance," *Semantic Scholar*, 2020. [Online]. Available: https://pdfs.semanticscholar.org/5493/a97ef7173b1cd14593444483ea5f96585514.pdf

[11] A. Roy *et al.*, "Automation Attendance Systems: Approaches — A Practical Review," *ResearchGate*, 2022. [Online]. Available: https://www.researchgate.net/publication/361304441_EasyChair_Preprint_Automation_Attendance_Systems_Approaches_a_Practical_Review

[12] W. Domingo *et al.*, "Technology Acceptance of QR Code Recognition as Attendance Monitoring," *ResearchGate*, 2024. [Online]. Available: https://www.researchgate.net/publication/394131906_Technology_Acceptance_of_QR_Code_Recognition_as_Attendance_Monitoring_on_School_Activities_Student_Organization_Officers_Perspective

[13] IJEMT, "QR Attendance Implementations," *IJEMT Journal*, 2024. [Online]. Available: https://ijemt.com/wp-content/uploads/2024/05/GSV-050424-01-IJEMT.pdf

[14] A. Student Group, "A Quick Response QR Code-Based Student Attendance," *Academia*, 2022. [Online]. Available: https://www.academia.edu/77744902/A_Quick_Response_QR_Code_Based_Student_Attendance_System

[15] M. Prasetyo *et al.*, "QR Code-Based Attendance System Using OpenCV," *Jurnal Mantik*, 2022. [Online]. Available: https://iocscience.org/ejournal/index.php/mantik/article/download/3775/2398