International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 06 June 2026
Page No: 4442 - 4448
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0581

A Voice Based Visual Product Identification for Blind Persons Using QR Code Scanning

Priyanka B Ghenand[1], Dr.Monika Dhananjay Rokade[2], Dr.Sunil Sudam Khatal[3]
[1]PG Student, Sharadchandra Pawar College of Engineering, Otur.
[2,3]Assistant Professor, Sharadchandra Pawar College of Engineering, Otur.
Email ID: *priyankaghenand15@gmail.com[1], Monikarokade4@gmail.com[2], Khatalsunils88@gmail.com[3]*

Abstract
Visually impaired individuals often face difficulties in identifying everyday products, particularly during shopping or managing household items, due to reliance on visual packaging. To address this challenge, we propose a voice-assisted product identification system that utilizes QR code scanning integrated with a Java-based web application. In this system, users can scan or upload a product's QR code, which is decoded using the ZXing library. The decoded information is then matched with a product database, and the details are delivered to the user via on-screen text and a text-to-speech engine. This approach enables visually impaired users to recognize products independently and reliably, without external help. The system is cost-effective, easily deployable on existing devices, and enhances autonomy and inclusivity by providing a practical solution for daily product identification.

Keywords: *QR Code, Voice-Assisted Identification, Accessibility, Product Management.*

1. Introduction

Visually impaired individuals encounter numerous challenges in performing daily tasks, particularly when it comes to identifying and managing products independently. Conventional product packaging relies heavily on visual cues, making it difficult for blind or low-vision users to access essential information such as product type, expiration date, or instructions [1]. Recent advancements in assistive technologies, including QR code scanning and mobile applications, have shown significant potential in addressing these accessibility issues [2], [3]. QR codes provide a convenient and cost-effective method to encode product information in a machine-readable format, which can be easily decoded using smartphones or dedicated scanning devices. When combined with voice-assisted interfaces, these systems can provide real-time auditory feedback, enabling visually impaired users to independently identify products without external assistance [4], [5]. Furthermore, integration with web applications and databases enhances scalability, allowing the system to manage a large variety of products efficiently [6]. Despite several solutions being proposed in literature, many still face limitations such as high implementation costs, limited coverage of products, or lack of robust voice feedback mechanisms [1], [7]. Therefore, there is a clear need for a reliable, user-friendly, and cost-effective system that leverages QR code technology and text-to-speech functionality to improve the autonomy of visually impaired users in daily product identification. The system proposed in this study addresses these gaps by providing an intuitive and practical solution suitable for everyday use.

2. Literature Survey

Arif, A., and S. Hussain. [1] an intelligent QR code scanning system designed specifically for visually impaired users. The system integrates QR code recognition with a voice-based interface to provide product information via audio output. Experimental results show that the system improves identification speed and reduces reliance on human assistance. The authors highlight usability considerations, ensuring that scanning is accurate even in suboptimal lighting or angle conditions. The study demonstrates a practical and cost-effective approach for enhancing accessibility in daily tasks such as shopping.Tran, Duc, et al. [2] consumers perceive blockchain-enabled food traceability and the role of QR codes in conveying product information. It investigates the impact of consumer ethnocentrism and communication strategies on willingness to pay for

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 06 June 2026
Page No: 4442 - 4448
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0581

traceable food products. Findings reveal that QR code-based information enhances trust and transparency, particularly among ethically and health-conscious consumers. The study highlights the effectiveness of QR codes in bridging technological solutions with consumer perception. It provides insights for supply chain stakeholders seeking to enhance traceability and consumer confidence. Borandag, Emin [3] a recycling management platform that combines blockchain, QR codes, image processing, and IoT technology. QR codes are used to track waste items, while blockchain ensures transparency and data integrity. The system automates waste classification and reporting using image recognition, improving efficiency in recycling operations. Experimental implementation demonstrates accuracy in identifying recyclable items and reliability in secure tracking. The study emphasizes sustainability benefits and the potential for broader adoption in smart waste management. Huo, Lina, et al. [4] an AI-based QR code recognition system aimed at improving decoding accuracy and speed. The system employs deep learning algorithms to detect and interpret QR codes even in distorted or noisy images. Comparative analysis shows that the AI-based approach outperforms traditional methods in terms of reliability and robustness. The paper also discusses computational efficiency and practical deployment considerations. Results indicate that AI-enhanced QR recognition has applications in accessibility, logistics, and retail systems. Fuentebella, Daroel M. [5] an Android application to help visually impaired individuals identify products using QR codes. The system integrates a camera-based scanning interface with a text-to-speech engine to relay product information audibly. Usability testing shows that the app is intuitive, reduces identification errors, and allows independent operation. The paper emphasizes low-cost implementation and compatibility with standard mobile devices. The solution contributes to accessibility and supports autonomy for blind users in daily tasks. Terzopoulos, George [6] the use of embossed QR codes as a tactile solution for visually impaired consumers. The study combines tactile feedback with standard QR scanning, allowing blind users to locate and interact with product codes easily. Experiments indicate improved usability and faster product recognition compared to traditional QR codes. The authors discuss design considerations for embedding tactile markers without affecting packaging aesthetics. The work highlights a novel approach to inclusivity in product labeling. Qu, Xinghua, et al. [7] a system that embeds audio watermarks into QR codes using deep neural networks. The approach allows secure and multi-modal information transfer, enabling QR codes to carry both visual and auditory content. Experimental results demonstrate high decoding accuracy and resistance to tampering or distortion. The study suggests applications in accessibility, secure product authentication, and multimedia content distribution. The method enhances traditional QR functionality by integrating audio-based verification. Vadher, Rivaa, et al [8] proposes a blockchain-based system to detect counterfeit products using QR codes. Each product is assigned a unique QR code linked to a blockchain ledger, ensuring authenticity verification at any point in the supply chain. The system prevents tampering and enables real-time validation by consumers and retailers. Results show significant improvement in fraud detection and transparency compared to conventional methods. The paper emphasizes the synergy of QR codes and blockchain for product security. Pranitha, G. A. D. D. E., [9] presents a decentralized blockchain-based approach for detecting counterfeit drugs using QR codes. QR codes carry drug information that is verified through consensus mechanisms on a blockchain network. The system ensures data integrity, reduces counterfeiting risks, and provides consumers with reliable drug authentication. Simulation results indicate enhanced security, traceability, and user confidence. The paper demonstrates the practical utility of combining QR codes and blockchain for pharmaceutical supply chain management. Perin, Max Angelo Dapitilla. [10] evaluates a QR code-based system for attendance monitoring in educational settings. The research focuses on usability, performance, and the efficiency of scanning processes for students and staff. Findings reveal that the system reduces manual errors, improves speed, and ensures reliable record-keeping. The paper also discusses factors affecting user experience, including scanning environment and

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 06 June 2026
Page No: 4442 - 4448
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0581

device compatibility. The study highlights the potential of QR code technology for administrative automation and efficiency improvement.

2.1. Overview of QR Codes

- **Definition:** Quick Response (QR) codes are two-dimensional barcodes designed to hold information in a format that can be easily read by machines.
- **Data Capacity:** They are capable of encoding various types of data, including text, website URLs, numerical values, and product details, with storage capacity reaching several thousand characters.
- **Structure:** The design of QR codes includes finder patterns positioned in three corners for alignment, timing patterns that help organize the data, and data modules that contain the encoded information.
- **Error Correction:** QR codes incorporate error correction at multiple levels (L, M, Q, H), enabling accurate reading even if part of the code is damaged or obscured.

3. Methodology

The proposed system is designed to enable visually impaired users to identify products independently using QR code scanning combined with voice guidance. The methodology involves a series of interrelated modules, as illustrated in Figure 1.

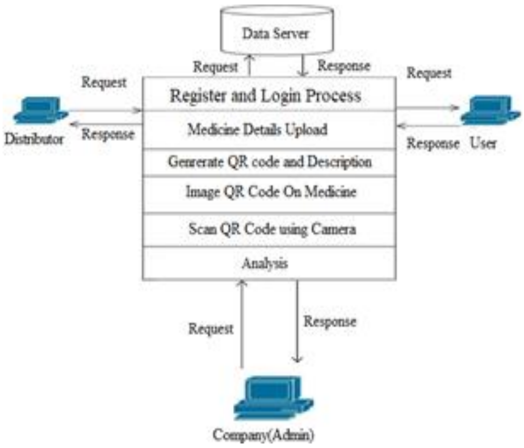

Figure 1 **System Architecture**

3.1. Process Module

- **QR Code Scanning:** The system allows users to either scan QR codes in real-time using a camera-enabled device or upload an image of the QR code through file input. This ensures flexibility in different usage scenarios.
- **QR Code Decoding:** Once the QR code is captured, it is decoded using the ZXing library to extract the embedded product information efficiently and accurately.
- **Database Mapping:** The decoded data is mapped to a centralized product database that contains essential details such as product name, category, expiration date, and price. This ensures reliable identification of the correct product.
- **Product Information Retrieval:** Based on the mapping, the system retrieves the corresponding product information from the database, ensuring that the user receives complete and accurate details.
- **Text Output:** For sighted users or caretakers, the identified product information is displayed on the interface screen in a readable format, supporting dual-mode access.
- **Voice Output:** To make the system accessible to visually impaired users, the retrieved product information is converted into speech using a text-to-speech (TTS) engine, providing real-time auditory feedback.

Function in the Voice-Based Product Identification System

- Every product is linked to a distinct QR code that holds information such as its name, category, price, and expiry date.
- Users can scan or upload the QR code through a device equipped with a camera.
- The system utilizes the ZXing library to decode the scanned QR code.
- Once decoded, the information is matched with the database to retrieve the relevant product details.
- Finally, the system provides both voice and text output, enabling visually impaired users to recognize and access product information independently.

3.2. QR Code Encoding Process

The QR code encoding procedure transforms readable information into a matrix of black and white modules. The major steps include:

3.2.1. Data Analysis

The input information—such as text, product identifiers, URLs, or numeric values—is evaluated to determine the most suitable encoding mode (numeric, alphanumeric, byte, or Kanji).

3.2.2. Data Conversion

After selecting the encoding mode, the data is translated into a binary bitstream following standard QR code encoding specifications.

3.2.3. Error Correction Coding

Reed–Solomon error correction codes are then incorporated. These codes allow the QR symbol to remain decodable even if up to 30% of it is damaged, depending on the selected error correction level (L, M, Q, or H).

3.2.4. Structure Finalization

The completed bitstream is broken down into code words and systematically placed into the QR matrix using predefined placement rules.

3.2.5. Masking Process

To improve scanning accuracy, one of the eight mask patterns is applied to the QR matrix, preventing visually confusing patterns.

3.3. QR Code Decoding Process (Using ZXing Library)

In the proposed application, the decoding operation is carried out with the help of the open-source ZXing (Zebra Crossing) library. The decoding workflow consists of the following stages:

3.3.1. Image Acquisition

The QR symbol is captured using a smartphone camera or provided as an uploaded image.

3.3.2. Preprocessing

ZXing performs initial processing that includes converting the image to grayscale, applying thresholding, and identifying the finder patterns.

3.3.3. Grid Sampling

The detected QR region is extracted, corrected for perspective distortions, and remapped into a standardized grid.

3.3.4. Error Correction Application

Reed–Solomon algorithms are used to restore any missing or corrupted portions of the encoded data.

3.3.5. Data Extraction

Finally, the recovered binary data is translated back into readable information such as product IDs, batch details, or additional embedded metadata.

- **QR Code Structure:** A typical QR code is composed of several essential elements, each designed to support reliable scanning and interpretation:
- **Finder Patterns:** These prominent square markers, placed at three corners of the QR code, help scanning devices instantly recognize the symbol and determine its orientation.
- **Alignment Patterns:** Smaller square modules distributed throughout the code assist in correcting distortions, enabling accurate decoding even when the QR image is bent, tilted, or viewed from an angle.
- **Timing Patterns:** These are sequences of alternating black and white modules arranged horizontally and vertically. They guide the decoder in identifying the grid dimensions of the QR matrix.
- **Format Information:** This section stores details about the selected error correction level and the mask pattern applied during the encoding process.

3.4. Data and Error Correction Regions

These regions contain the actual encoded message along with the Reed–Solomon error correction codewords, ensuring the QR symbol can still be decoded correctly even if parts of it are damaged or obscured.

3.5. Algorithm Design

QR Code Write

Input: String data d from unique-id

Output: QR code Image

- **STEP 1:** Start
- **STEP 2:** Input the source file (d)
- **STEP 3:** Convert string into byte and store in d
- **STEP 4:** Input the image format and resolution of the QR Code to be generated
- **STEP 5:** Input Error Correction Level
- **STEP 6:** Using zxing[1] library method convert ‘d’ into a BitMatrix object ’bitmatrix’
- **STEP 7:** Write bitmatrix to an image
- **STEP 8:** End

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 06 June 2026
Page No: 4442 - 4448
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0581

3.6. N.B- BitMatrix represents a 2D matrix of bits

QR Code Read
Input: Input QR Code image and charset.
Output: show unique-id

- **STEP 1:** Start
- **STEP 2:** Input QR Code image
- **STEP 3:** Construct a Binary Bitmap object 'bitmap' from source image
- **STEP 4:** Using zxing library method decode the 'bitmap' and store it in the object 'result'
- **STEP 5:** Convert 'result' into string and write it to 'result'
- **STEP 6:** Extract result
- **STEP 7:** If requested by user call readQRCode ('supek', 'sig', infile)
- **STEP 6:** End

3.7. Mathematical Model

A System has represented by 5-different phases, each phase works with own dependency System

$$S = (Q, \sum, \delta, q_0, F)$$

Where:

$$Q=\{q0,q1,q2,q3,q4\}$$

- **q0:** Initial product data input state
- **q1:** QR code creation/encoding
- **q2:** QR code scanning/reading
- **q3:** Database validation & product verification
- **q4:** Voice/Text output state (final detection)

3.8. Input Alphabet (Σ)

$$\Sigma= \{createQR, readQR, decode, validate, voiceOutput\}$$

These symbols represent system operations:

- createQR → Generate QR code
- readQR → Scan QR image
- decode → Extract product information
- validate → Check product ID, manufacturing date, expiration date
- voiceOutput → Convert result into speech

3.9. Transition Function (δ)

$$\delta: Q\times\Sigma\rightarrow Q$$

δ = detect the medicine all validation process

3.10. Initial State (q_0)

$$q0 = \text{Initial transaction } T\ [0]$$

Represents the initial transaction, where product details such as:

- Product ID
- Manufacturing Date
- Expiration Date
- Price
- Company Name

3.11. Final State (F)

$$F = \{\text{Read QR Code}\}$$

State = According to achieved medicine name system detection

- 1: if all QR Code to displayed as text and converted voice.
- 0: If not,all QR Code to displayed as text and converted voice

4. Results

Testing the proposed system for effectiveness and scalability entailed working with varying amounts of products. For each product, the expiration date was obtained from the Product Information Service, added to the QR code as a string, and then scanned/decoded with the ZXing tool Shown in Table 1. The expiration date from the database was used for comparison to verify accuracy. The product data, including expiration, was added to a QR code image of size 200 x 200, with UTF-8 encoding, and error correction set to level L. The created QR codes were scanned, tested, and decoded to test data integrity and detection accuracy Shown in Figure 2.

- N=Total products tested
- C=Correct expiration detections
- Accuracy=C/N*100

Table 1 Expiration Date Detection Accuracy Vs Number of Products

Products Tested	Correct Detections	Incorrect	Accuracy (%)
5	5	0	100
10	9	1	90
15	14	1	93.3
20	19	1	95

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 06 June 2026
Page No: 4442 - 4448
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0581

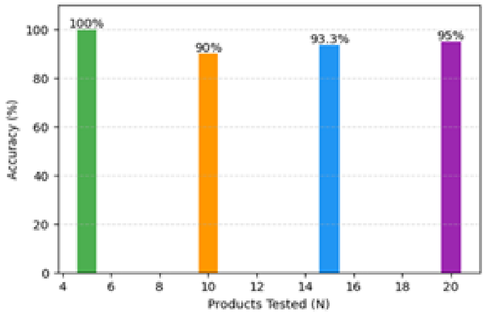

Figure 2 Expiration Date Detection Accuracy Vs Number of Products

The vertical bar graph showcases how accurate the proposed QR-based product identification system is for varying numbers of products tested. The system was able to correctly identify all five products with no errors. The only recorded detection error for the next test of ten products was due to a decoding error which caused the total percentage to drop to 90%. The system recorded 93.3% accuracy for 15 products and 95% accuracy for 20 products, therefore, it is safe to say the system and its results speak for themselves. The system is exceeding 90% accuracy more than once, and is showing to be extremely robust and scalable for real-world use. The only noted environmental setbacks in the system's ability to identify products are the alignment of the cameras and the ambient light.

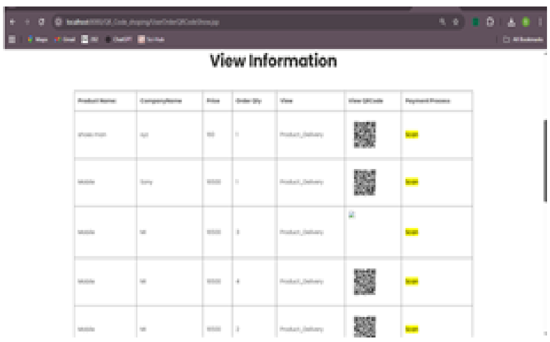

Figure 3 illustrates the implemented web-based interface of the proposed Voice-Based Visual Product Identification System

The Figure 3 system scans the QR code to check the product ID, manufacturing date, and expiration date. These parameters are checked against the system database. Each field is checked and verified. If the three parameters matched the database, the product is genuine, and the system allows the user to continue to payment. If any one of the three fields fails (product ID, manufacturing date, expiration date), the system marks the product as fake.

Table 2 QR Code Creation and Writing Time

Number of Products	Avg. Creation Time (ms)	Avg. Writing Time (ms)	Total Time (ms)
5	12	8	20
10	13	9	22
15	14	10	24
20	15	11	26

In Table 2, it shows how much time it takes to create and store QR codes for various amounts of products. The system is fast, and the time for each QR code is between 20 and 26 milliseconds. The small increase in time when there are more products is because of the extra encoding and file I/O operations. The increase is so small that it proves that the system can generate QR codes in real time, and can be used in real world situations for retail and authentication.

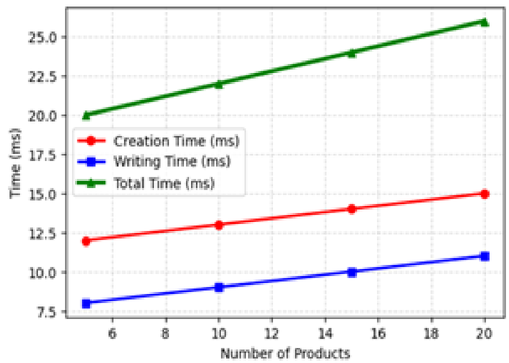

Figure 4 QR Code Creation and Writing Time vs Number of Products

Figure 4 shows how long it took to encode QRs, write images, and do overall processing. Even when the number of products increases, the total processing time is still less than 30 ms which shows that the system can do real time QR code generation, confirming that it can be used in real-life situations.

Conclusion

The proposed Voice-Based Visual Product Identification System offers an accessible, cost-effective, and user-friendly solution for blind individuals to identify everyday items independently. By integrating QR code scanning, database mapping, and text-to-speech output within a Java-based web interface, the system ensures reliability and inclusivity. It minimizes reliance on others, enhances personal autonomy, and contributes to improving the overall quality of life for people who are blind or visually impaired.

References

[1]. Arif, A., and S. Hussain. "An intelligent QR code scanning system for visually-impaired users." 2022 Third International Conference on Latest trends in Electrical Engineering and Computing Technologies (INTELLECT). IEEE, 2022.

[2]. Tran, Duc, et al. "Consumers' valuation of blockchain-based food traceability: role of consumer ethnocentrism and communication via QR codes." British Food Journal 126.13 (2024): 72-93.

[3]. Borandag, Emin. "A blockchain-based recycling platform using image processing, QR codes, and IoT system." Sustainability 15.7 (2023): 6116.

[4]. Huo, Lina, et al. "Research on QR image code recognition system based on artificial intelligence algorithm." Journal of Intelligent Systems 30.1 (2021): 855-867.

[5]. Fuentebella, Daroel M., Richelle S. Lobo, and Kristine T. Soberano. "ANDROID-BASED PRODUCT IDENTIFICATION FOR VISUALLY IMPAIRED INDIVIDUALS." Globus-An International Journal of Management & IT 15.2 (2024).

[6]. Terzopoulos, George, Ioannis Kazanidis, and Avgoustos Tsinakos. "Using Embossed QR Codes on Product Packaging for People with Visual Impairments." European Journal of Interdisciplinary Studies 14.2 (2022).

[7]. Qu, Xinghua, et al. "AudioQR: Deep Neural Audio Watermarks for QR Code." IJCAI. 2023.

[8]. Vadher, Rivaa, et al. "QR based Fake Product Detection using Blockchain." (2024).

[9]. Pranitha, G. A. D. D. E., and P. V. Lakshmi. "Fake drug detection using QR codes and consensus based security enhancement in decentralized blockchain system." Journal of Theoretical and Applied Information Technology 102.4 (2024): 1354-1368.

[10]. Perin, Max Angelo Dapitilla. "Technology-assisted attendance monitoring: A case study on QR code system usability and performance." Journal of Technology-Assisted Learning 1.2 (2025): 115-123.