



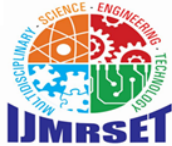
International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.864

Volume 9, Issue 5, May 2026



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Drug Recognition through Voice and Image Classification Engine (DR. VOICE)

Aicess D. Barunday¹, Grace Ann M. Petallo¹, Patrick R. Salavedra¹, Engr. Cheryl O. Tayo, MIT, MSCpE², Engr. Dione S. Duero, MSCpE³, Engr. Franklin M. Ganancias, DIT⁴,
Engr. Nelyne Lourdes Y. Plaza, PCpE, PhD⁵

Undergraduate Student, Department of Computer Studies, North Eastern Mindanao State University - Cantilan Campus, Cantilan, Surigao del Sur, Philippines¹

Associate Professor IV, Department of Computer Studies, North Eastern Mindanao State University - Cantilan Campus, Cantilan, Surigao del Sur, Philippines²

Instructor I, Department of Computer Studies, North Eastern Mindanao State University - Cantilan Campus, Cantilan, Surigao del Sur, Philippines³

Associate Professor III, Department of Computer Studies, North Eastern Mindanao State University - Cantilan Campus, Cantilan, Surigao del Sur, Philippines⁴

Professor VI, Department of Computer Studies, North Eastern Mindanao State University - Cantilan Campus, Cantilan, Surigao del Sur, Philippines⁵

ABSTRACT: DR.VOICE (Drug Recognition through Voice and Image Classification Engine) was developed to assist elderly users in accurately identifying medicines and reducing medication errors. The system integrates a Raspberry Pi 3 Model B+, YOLOv8-based image recognition, and voice-assisted feedback for real-time drug classification and confirmation. The study utilized 50 medicine samples for training and testing, and evaluated the system through accuracy testing and user assessment using a Likert-scale questionnaire. Evaluation results showed high recognition performance and strong user satisfaction in terms of usability, reliability, and effectiveness. The findings confirm DR.VOICE as a practical and accessible medication assistance tool for elderly care.

KEYWORDS: Drug Recognition, YOLOv8, Raspberry Pi, Medication Management, Voice Assistance

I. INTRODUCTION

Medication errors continue to be a major healthcare concern, particularly among elderly individuals who often experience difficulties in correctly identifying and managing their medications. Factors such as poor eyesight, memory decline, cognitive impairment, and complex prescription regimens contribute to increased risks of incorrect drug intake. These errors may result in reduced treatment effectiveness, serious health complications, hospitalization, or even life-threatening conditions. As the elderly population grows and polypharmacy becomes more common, improving medication safety has become increasingly essential.

The World Health Organization [1] identified medication errors as one of the leading causes of preventable harm globally, with older adults being among the most vulnerable groups. Supporting this, [2] demonstrated that deep learning-based pill recognition systems using image classification can significantly improve drug identification accuracy and reduce medication-related errors. In addition, [3] highlighted that voice-assisted healthcare technologies enhance usability and accessibility for elderly users by reducing cognitive load and improving interaction with digital systems. These studies emphasize the potential of integrating artificial intelligence and assistive technologies to improve medication safety and user experience.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

In response to these challenges, this study developed DR.VOICE (Drug Recognition through Voice and Image Classification Engine), a portable medication assistance system that integrates image-based medicine recognition with voice-assisted feedback and mobile medication management. The system is designed to provide real-time drug identification, spoken confirmation, and accessible medication information, thereby improving safety, usability, and adherence among elderly users. Ultimately, DR.VOICE aims to enhance independence and reduce medication errors through an intelligent and user-centered healthcare solution.

II. LITERATURE REVIEW

A critical review of related literature and studies has been conducted to establish the relationship between the present study and prior research in the field of digital health technologies and medication management systems. In recent years, healthcare systems have increasingly adopted artificial intelligence and mobile-based solutions to address the growing complexity of patient care, particularly among elderly individuals who often manage multiple prescriptions. However, despite these technological advancements, medication safety, usability, and accessibility remain persistent challenges. Elderly users continue to experience difficulties due to age-related limitations such as declining vision, memory impairment, and reduced cognitive function. As a result, researchers have emphasized the need for integrated, intelligent, and user-centered systems that can support accurate medication identification and improve adherence. Although many studies have explored digital health tools, most remain fragmented and do not fully combine drug recognition, voice assistance, and medication management in a single platform. While significant progress has been made in this field, there is still a clear need for more comprehensive and accessible solutions tailored to elderly users. Recent studies have emphasized the growing importance of artificial intelligence and digital health technologies in improving medication management, particularly among elderly individuals. [2] developed a deep learning-based pill recognition system that uses image classification to accurately identify pharmaceutical products. Their study addressed the challenge of visually similar medicines by applying convolutional neural networks, which significantly improved classification accuracy and reduced medication identification errors. Similarly, [3] proposed a mobile-based pharmaceutical recognition system capable of real-time drug identification. Their findings demonstrated that AI-driven medicine recognition systems can operate effectively under different conditions, supporting the use of image-based classification in healthcare applications.

In addition to medicine recognition, researchers have also highlighted the importance of accessibility and usability in digital healthcare systems. [4] conducted a systematic review on voice-enabled healthcare technologies and found that voice interaction improves usability, accessibility, and engagement among elderly users. Their study revealed that voice-assisted systems reduce cognitive burden and help individuals with limited digital literacy interact more effectively with healthcare applications. Likewise, [5] reported that artificial intelligence-based patient support systems incorporating reminders, monitoring, and feedback mechanisms significantly improve medication adherence. Supporting this finding, [6] demonstrated that structured digital medication management systems can reduce hospital readmissions among elderly patients with polypharmacy.

Local studies also emphasized the medication management challenges experienced by elderly Filipinos. Acuña et al. [7] found that polypharmacy among elderly individuals in Cavite increases the risk of medication errors due to limited health literacy and confusion regarding medication instructions. Similarly, [8] reported that medication adherence among elderly patients in Surigao City is strongly influenced by patients' understanding of dosage instructions, communication with healthcare providers, and perceived medication effectiveness. [9] further highlighted that elderly patients are more likely to follow medication regimens when they clearly understand treatment instructions and trust healthcare guidance. In addition, [10] identified forgetfulness and insufficient understanding of medication instructions as common causes of poor medication adherence among Filipino hypertensive patients. Their findings suggested that simplified educational and reminder-based systems can improve adherence rates. Furthermore, [11] developed a mobile Medication Reminder and Tracker Application that helped users organize medication schedules and improve compliance, particularly among individuals managing multiple prescriptions.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Table.1. Summary of Relevant Literature

No.	Paper Title	Author Name	Key Points	Remark
1	Deep Learning-Based Pill Recognition System	Heo et al. (2023)	Image classification improves accuracy in drug identification.	Supports image recognition in DR.VOICE.
2	Mobile Pharmaceutical Recognition System	Zhang et al. (2023)	CNN models enable real-time and accurate drug identification	Validates mobile drug recognition approach
3	Voice-Enabled Digital Health Technologies Review	Sezgin et al. (2022)	Voice systems improve accessibility and reduce cognitive load for elderly users	Supports voice-assisted features in DR.VOICE
4	AI-Based Patient Support Systems Review	Reis et al. (2025)	Reminder and monitoring systems improve medication adherence	Supports inclusion of reminders and tracking features
5	Digital Medication Interventions and Outcomes	Poorcheraghi et al. (2023)	Structured digital systems reduce hospital readmissions in elderly patients	Supports integrated digital health approach
6	Medication Practices Among Elderly in Cavite	Acuña et al. (2023)	Polypharmacy increases medication error risk due to low health literacy	Shows local need for simplified systems
7	Factors Affecting Medication Adherence	Benite et al. (2024)	Understanding dosage instructions strongly affects adherence	Supports need for clear medication guidance
8	Medication Adherence and Trust in Physicians	Santiago et al. (2026)	Trust and perceived effectiveness improve adherence behavior	Highlights importance of user confidence
9	Medication Adherence in Filipino Patients	Gutierrez et al. (2023)	Forgetfulness and poor understanding cause non-adherence	Justifies reminder and assistance features
10	Medication Reminder and Tracker Application	Catindoy et al. (2024)	Mobile reminder systems improve medication organization and adherence	Supports DR.VOICE mobile tracking system

In summary, the present study is grounded on previous research that explores how digital health technologies can improve medication safety, accessibility, and adherence among elderly individuals. While earlier studies have focused on isolated aspects such as drug identification, reminder systems, or voice-assisted interaction, the current study integrates these elements into a single, unified system. The authors of this study, through the development of the DR.VOICE system, focus on addressing the combined challenges of medication errors, polypharmacy, and limited digital accessibility experienced by elderly users. In doing so, this research extends prior work by examining how an integrated approach using image-based drug recognition and voice-assisted feedback can enhance medication management effectiveness and support safer, more independent healthcare practices among elderly individuals in the digital age.

III. METHODOLOGY

Research Design

This study employed a developmental research design to evaluate the DR.VOICE portable medication support system powered by machine learning. It focused on assessing the system's ability to accurately identify medicines and provide voice-assisted feedback for elderly users. The study addressed medication management challenges such as difficulty in medicine recognition, memory decline, and visually impaired. The final prototype was validated through actual testing to determine its effectiveness, usability, and reliability as a portable medication assistance device.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Instruments

The system was evaluated using a structured survey instrument based on a 5-point Likert Scale to measure the usability, functionality, reliability, and acceptability of the DR.VOICE system. Data collection used a rating scale ranging from 5 (Strongly Agree) to 1 (Strongly Disagree) to ensure consistent and quantifiable assessment of user experience and system effectiveness. This evaluation focused on key dimensions including usability, functionality, reliability, and acceptability of the developed system.

In addition, system testing procedures were conducted as part of the evaluation instrument to measure the technical performance of the system. This included assessing medicine recognition accuracy, response time, and overall system stability during operation. The combination of user-based evaluation and technical testing provided a comprehensive assessment of the DR.VOICE system in terms of both user satisfaction and system performance.

Data Collection and Participants

A total of 50 participants were selected through convenience sampling. The respondents consisted of elderly individuals, students, and professionals from North Eastern Mindanao State University (NEMSU), Cantilan Campus. Elderly participants represented the primary target users of the system, while students and professionals provided additional perspectives on usability and functionality. Prior to evaluation, participants were given a demonstration of the DR.VOICE system to ensure proper understanding of its features and operation. Data collection was conducted after system interaction to ensure informed and accurate feedback.

Data Gathering Procedure

Medicine images were collected using a cellphone camera under controlled lighting conditions with a uniform black background to ensure consistency and image quality. The dataset included tablets, capsules, and liquid medicines. Collected images were uploaded to Roboflow for annotation and labeling, then divided into training, validation, and testing sets.

System performance data, including recognition accuracy and response time, were obtained through controlled testing. User feedback was gathered through structured questionnaires evaluating usability, functionality, reliability, and acceptability. All data were organized for statistical analysis.

Datasets Description

The dataset used in this study consisted of images of fifty (50) medicine samples composed of tablets, capsules, and one liquid-based medicine. Approximately two hundred (200) images were collected for each medicine using a cellphone camera. A black background was consistently used during image capture to reduce noise and improve object visibility. This setup helped the model focus on important medicine features such as color, shape, and size.

All images were uploaded and annotated using Roboflow. The dataset was divided into training, validation, and testing subsets. The training dataset enabled the model to learn distinguishing medicine features, while the validation and testing datasets were used to evaluate performance and reliability. The consistent background and organized dataset preparation contributed to improved recognition accuracy and model stability.

Data Preprocessing

Data preprocessing was conducted to improve dataset quality and model performance. The collected images were resized into a uniform resolution compatible with YOLOv8. Pixel normalization was also applied to standardize image values and improve model learning efficiency. Duplicate, unclear, and low-quality images were removed from the dataset. Labels were carefully reviewed to ensure each medicine image was correctly classified. After preprocessing, the dataset was split into training, validation, and test sets to support proper model evaluation and reduce bias during training.

YOLOv8

This study employed YOLOv8, a modern object detection model developed by Ultralytics, for medicine identification. YOLOv8 combines object localization and classification into a single-stage detection process, enabling fast and efficient real-time recognition. Transfer learning was applied by fine-tuning a pre-trained YOLOv8 model using the annotated medicine dataset. The model generated bounding boxes, labels, and confidence scores for detected



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

medicines. Because of its speed, accuracy, and capability to detect small objects, YOLOv8 was selected as the primary recognition model for the DR.VOICE system.

Training Process

The training stage was conducted to teach the YOLOv8 model how to recognize different medicine samples accurately. During this process, the prepared dataset was introduced to the model so it could learn the visual characteristics and patterns of each medicine type. The training procedure is essential because it enables the system to distinguish medicines based on their appearance. Training was performed using Google Colab, which provided a cloud-based environment for model development and execution. The dataset was separated into training, validation, and testing subsets to support proper evaluation of model performance. Pre-trained weights were also utilized to improve learning efficiency and shorten training duration. The model underwent multiple training epochs to gradually improve detection capability and classification accuracy. The system’s performance was assessed throughout the process using metrics such as loss, precision, recall, F1-score, and mean average precision (mAP). After completing the training phase, the model was validated and tested to verify reliability and accuracy. The best-performing model was selected and integrated into the DR.VOICE system for real-time medicine recognition.

Data Analysis

Data analysis in the study involved evaluating both the technical performance and user feedback of the DR.VOICE system. The system’s effectiveness was measured using performance metrics from the confusion matrix, including accuracy, precision, recall, F1-score, and specificity. In addition, responses from the 5-point Likert Scale questionnaire were analyzed using mean computation to assess usability, functionality, reliability, and acceptability. This combined approach provided a clear evaluation of both system performance and user experience.

IV. RESULTS & DISCUSSION

System Performance Results

The DR.VOICE system achieved a high overall recognition accuracy of approximately 96%, indicating strong performance in identifying different types of medicines. The confusion matrix results showed that most predictions were correctly classified, forming a strong diagonal pattern, with only minimal misclassifications due to similarities in color, shape, and packaging of certain medicines.

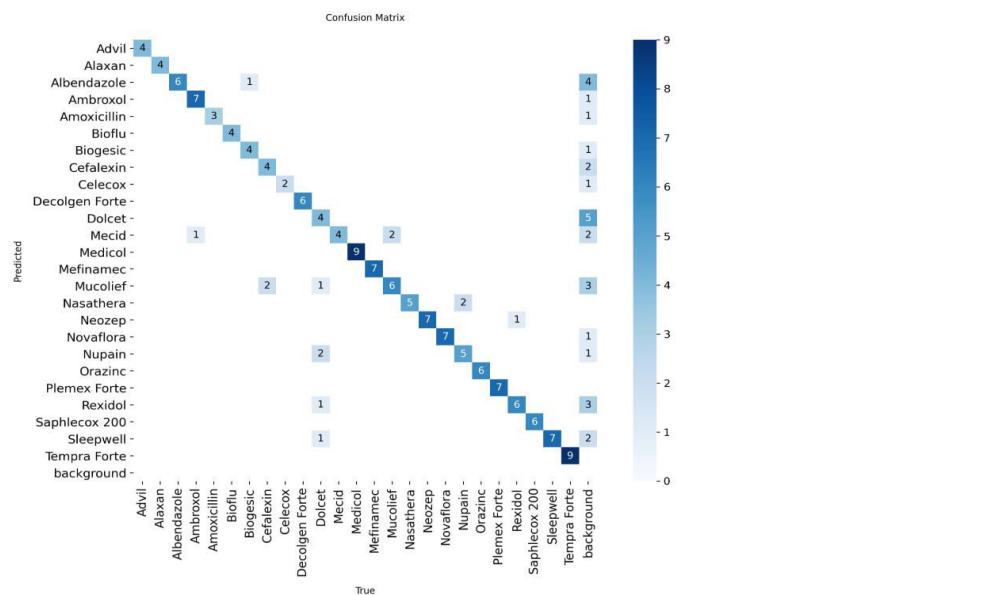


Figure 1: Confusion Matrix from the Tablet and Capsule Identification



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

These findings are consistent with the study of [2], who reported that deep learning-based pill recognition systems significantly improve drug identification accuracy. Similarly, the use of YOLOv8 in this study demonstrated efficient real-time detection, supporting its suitability for embedded healthcare applications.

Performance Evaluation

The system was evaluated using a structured questionnaire focusing on functionality, usability, reliability, and acceptability. As shown in Table 2, all indicators received high ratings ranging from 4.38 to 4.60, interpreted as “Strongly Agree.”

Table.2. Summary of DR.VOICE System Evaluation Results

Table	Category	Mean	Interpretation
1	Functionality	4.53	Strongly Agree
2	Usability	4.53	Strongly Agree
3	Reliability	4.60	Strongly Agree
4	Overall Acceptability	4.38	Strongly Agree
	Overall Mean	4.51	Strongly Agree

The results indicate that respondents found the system easy to use, reliable, and highly beneficial, especially for elderly users. This supports the findings of [3], who emphasized that voice-assisted technologies improve accessibility and reduce cognitive load among older adults.

Response Time and System Efficiency

The system operates with an average response time of 5–10 seconds, covering image capture, processing, and voice output. While this is acceptable for real-time use, slight delays were observed under poor lighting conditions or improper camera positioning. Compared to similar embedded AI systems, the performance is considered efficient given the limitations of Raspberry Pi hardware. Previous studies also highlight that edge-based AI systems often experience trade-offs between accuracy and processing speed, especially in real-time healthcare applications.

Discussion

The findings of the study showed that the DR.VOICE system effectively identifies medicines and assists elderly users through image recognition and voice-assisted feedback. The system achieved a 96% recognition accuracy, demonstrating reliable real-time performance with only minimal errors caused by environmental conditions and similarities in medicine appearance. The system also maintained an acceptable response time of 5–10 seconds during operation.

User evaluation results indicated high satisfaction in terms of functionality, usability, reliability, and acceptability. Respondents found the system easy to use, accessible, and helpful in medication management, especially due to its voice-assisted guidance. The findings support previous studies on deep learning-based medicine recognition and voice-assisted healthcare technologies, confirming that DR.VOICE is an effective and practical solution for improving medication safety and adherence among elderly users.

V. CONCLUSION

The study successfully developed and evaluated DR.VOICE (Drug Recognition through Voice and Image Classification Engine), a portable medication assistance system designed to support elderly individuals in identifying medicines accurately. By integrating YOLOv8 image recognition, voice-assisted feedback, and Raspberry Pi technology, the system provided real-time medicine identification and accessible medication information.

Evaluation results showed that the system achieved high recognition accuracy, reliable performance, and positive user feedback in terms of usability, functionality, and acceptability. The findings indicate that DR.VOICE can effectively help reduce medication errors and improve medication management among elderly users. The study demonstrates the



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

potential of combining artificial intelligence and assistive healthcare technologies to promote safer, more accessible, and user-friendly medication practices.

Recommendations

Considering the findings and limitations encountered during the study, the following recommendations are suggested:

1. Future studies may include additional medicine categories, packaging variations, and larger image datasets to further improve recognition performance.
2. The hardware setup may be upgraded by using a newer Raspberry Pi model with larger RAM to enhance processing speed and reduce detection delays.
3. Additional image enhancement and preprocessing techniques may be applied to improve performance under varying lighting conditions and image quality.
4. Future improvements may focus on making the device more compact, durable, portable, and energy-efficient for daily use.
5. Further evaluation across a wider range of participants and testing environments is recommended to verify the system's reliability and usability in real-world conditions.

REFERENCES

- [1] World Health Organization, "Medication without harm: Global patient safety challenge," 2023.
- [2] J. Heo et al., "An accurate deep learning-based system for automatic pill identification," *Journal of Medical Internet Research*, 2023.
- [3] T. Bickmore and T. O'Leary, "Conversational agents on smartphones and the web," in *Digital Therapeutics for Mental Health and Addiction*, 2023.
- [4] A. Sezgin et al., "Voice-enabled digital health technologies and usability for older adults," systematic review, 2023.
- [5] R. Reis et al., "Artificial intelligence-based patient support systems and medication adherence," review study, 2024.
- [6] H. Poorcheraghi et al., "Mobile drug management system and hospital readmission reduction," *BMC Health Services Research*, 2023.
- [7] A. Acuña et al., "The prevalence of polypharmacy in elderly patients in Cavite," *GreenPrints*, 2023.
- [8] Benite et al., "Factors affecting medication adherence among elderly patients in Surigao City," 2023.
- [9] Santiago et al., "Trust and medication adherence among elderly patients," 2022.
- [10] M. M. Gutierrez et al., "Medication adherence among Filipino hypertensive patients: Systematic review," *Philippine Journal of Science*, 2023.
- [11] V. O. Catindoy et al., "Medication reminder and tracker application," *ICVEE*, 2024.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com