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Medicine Identification System using YOLOv9 and CNN

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A B S T R A C T

The medicine identification system is designed to correctly identify and classify drugs the use of pc vision techniques, especially You only look once version 9 (YOLOv9) and Convolutional Neural Networks (CNN). The system is supposed to help healthcare experts, pharmacists, and purchasers in figuring out medicinal drugs via studying images of drugs packaging and labels. YOLO v9 is employed for its actual-time object detection talents, which permit the system to quick hit upon and localize the medication in an image, even in cluttered or complex environments. After detecting the medication, a CNN is used to categories the medication primarily based on functions extracted from the detected area. This -step approach ensures excessive precision and accuracy in figuring out drugs from diverse angles and conditions, whilst minimizing the possibilities of misclassification. The system objectives to offer crucial facts approximately the medication, which include its name, dosage, and utilization instructions, consequently reducing the chance of errors associated with medication identification. The accuracy of the system should be 87%. The proposed model is skilled on a dataset comprising a wide variety of drugs images and packaging, permitting strong performance throughout extraordinary scenarios. via leveraging YOLOv9's speed and CNN's type electricity, this system represents a enormous development in healthcare generation, improving both accessibility and safety in medication use.

Keywords: Medicine Identification, YOLOv9, Convolutional Neural Networks (CNN), Object Detection, Deep Learning.

1. Introduction

Medicine identification system is an advanced technology inclusive of YOLOv9 for real-time object detection and Convolutional Neural Networks (CNN) for specific category, this utility aims to revolutionize the procedure of drug identification. Ensuring the perfect identification of medicinal drugs may be a difficult and time- consuming undertaking, regularly liable to human mistakes. traditional manual methods are not best labor- extensive but also susceptible to mistakes that could lead to extreme results. an automated technique that as it should Creation inside the healthcare area, accurate drug identification is crucial to save you complications that can get up from wrong medicine management. The aim of this venture is to provide a sturdy answer that allows people to upload pics of drugs and acquire specific descriptions, which include the call and brand of the medicine. with the aid of leveraging be recognizes pictures of drug treatments and returns relevant records right away can drastically mitigate these dangers.

Creation inside the healthcare area, accurate drug identification is crucial to save you complications that can get up from wrong medicine management. The aim of this venture is to provide a accurate medicine identification system that allows people to upload images of drugs and acquire specific descriptions, which include the call and brand of the medicine. with the aid of leveraging advanced technologies inclusive of YOLOv9 for actual-time item detection and Convolutional Neural Networks (CNN) for specific category, this utility aims to revolutionize the procedure of drug identification. Ensuring the perfect identification of medicinal drugs may be a difficult and time- consuming undertaking, regularly liable to human mistakes. traditional manual methods are not best labor- extensive but also susceptible to mistakes that could lead to extreme results. an automated technique that as it should be recognizes images of drug treatments and returns relevant records right away can drastically mitigate these dangers.

2. Literature Survey

In today's era accurate medicine identification is a crucial task to identify medicine. Aim of the system is to identify and classify the medicine images. Joseph, R., & Ghosh, P. [1] Proposed that an Efficient Medicine Identification System Using Deep Learning Techniques. International Journal of Innovative Technology and Exploring Engineering. This paper presents an efficient medicine identification system leveraging deep learning techniques, highlighting the need for accuracy in identifying medications from images. Liu, W., et al. [2] Proposed that a Deep Learning Approach for Object Detection in Medical Images. IEEE Transactions on Medical] imaging. The authors propose a deep learning approach for object detection in medical images, focusing on improving accuracy and reliability in medical diagnostics. Wang, Y., et al. [3] Proposed that a Real-time Detection of Medications Using YOLOv4. Journal of Healthcare Engineering. This research discusses real-time detection of medications using YOLOv4, showcasing its effectiveness for quick and accurate identification in healthcare settings. Zhang, Y., & Wu, Z. [4] Proposed that a Deep Learning Method for Identifying Pharmaceutical Products from Images. Journal of Image and Graphics. The paper introduces a deep learning method for identifying pharmaceutical

products from images, emphasizing the integration of advanced neural networks for better classification. Bozoghlanian, M., & Nasr-E sfahani , M . [5] Proposed that a Drug Identification System Based on YOLO and CNN. International Journal of Pharmacy and Pharmaceutical Sciences. The authors propose a drug identification system combining YOLO and CNN, demonstrating improved detection capabilities for various medications. Shi, Y., et al. [6] Proposed that a Enhancing Object Detection in Medical Imaging Using YOLOv5. Journal of Medical Systems. This study enhances object detection in medical imaging using YOLOv5, focusing on optimizing performance and detection accuracy in challenging environments. Alkhaleefah, M., et al. [7] Proposed that a Smart Medicine Identification Using Convolutional Neural Networks. Health Information Science and Systems. The paper presents a smart medicine identification system using Convolutional Neural Networks (CNNs), underlining the system's effectiveness in recognizing a wide range of pharmaceuticals. Chen, C., et al. [8] Proposed that a Novel Object Detection Framework for Medicine Recognition. Applied Sciences. The authors propose a novel object detection framework for medicine recognition, contributing innovative methodologies to improve accuracy in identifying medical products. Kumar, A., & Kaur, R. [9] Proposed that an Efficient Deep Learning Model for Medicine Classification Using CNN. This research develops an efficient deep learning model for medicine classification using CNN, focusing on enhancing performance metrics in drug identification tasks. Alhassan, H., et al. [10] Proposed that an Object Detection Techniques in Medical Imaging: A Review. Artificial Intelligence in Medicine. A review on object detection techniques in medical imaging is provided, summarizing various methods and their applications in the identification of pharmaceuticals. Ranjan, P., & Prasad, R. [11] Proposed that a Review on YOLO Framework for Object Detection. International Journal of Computer Applications. The paper reviews the YOLO framework for object detection, discussing its advantages and limitations in various applications, including medicine identification. Khan, M. A., et al. [12] Proposed that an CNN-based Drug Identification Using Visual Recognition. Journal of Drug Delivery Science and Technology. This research proposes a CNN-based drug identification system using visual recognition techniques, aiming to enhance the precision of medication identification in clinical settings.

3. Materials and Methods

3.1 Dataset Description

3.1.1 MedMNIST Dataset

The MedMNIST dataset [13] is a well-curated collection of medical images designed to benchmark machine learning algorithms in the healthcare domain. Its primary purpose is to facilitate the development and evaluation of image classification models, covering various medical imaging tasks. The dataset features multiple image modalities, including X-rays, histopathology, and MRI scans, and is structured similarly to the well-known MNIST dataset for handwritten digits. While it does not focus exclusively on medication packaging, it encompasses a wide range of medical images that can be beneficial for general medical applications.

3.1.2 Flickr Drug Dataset

The Flickr Drug Dataset [14] serves as a vital aid for researchers and builders operating on medicinal drug identity systems the usage of computer vision techniques. This dataset features a huge array of snap shots, totaling numerous thousand, which depict diverse sorts of medicinal drugs, consisting of drugs, drugs, liquid bottles, and packaging. The snap shots are gathered from the Flickr platform, making an allowance for wealthy diversity in presentation— starting from expert product snap shots to candid shots in normal settings.

3.2 Proposed system

The proposed medicinal drug identity device leverages the strengths of YOLOv9 and Convolutional Neural Networks (CNNs) to create an efficient and accurate answer for figuring out medicines from pictures. YOLOv9 is utilized for its superior real-time item detection capabilities, allowing the device to swiftly and appropriately locate medicinal drug packaging in diverse conditions, inclusive of different lights and angles. This version’s excessive-speed processing ensures that the device can cope with more than one pictures speedy, that is vital for dynamic healthcare environments. YOLOv9’s capacity to locate and localize the medication within an photo bureaucracy step one of the identity method. Following detection, an CNN is hired to classify the detected medicinal drug primarily based on its visible capabilities along with form, paragraph, and coloration.

The CNN version is skilled on an complete dataset of medicine pictures to ensure accurate category. as soon as identified, the device gives precise information about the medication, inclusive of its call, dosage, and usage instructions, enhancing the user’s capacity to address medicines accurately.

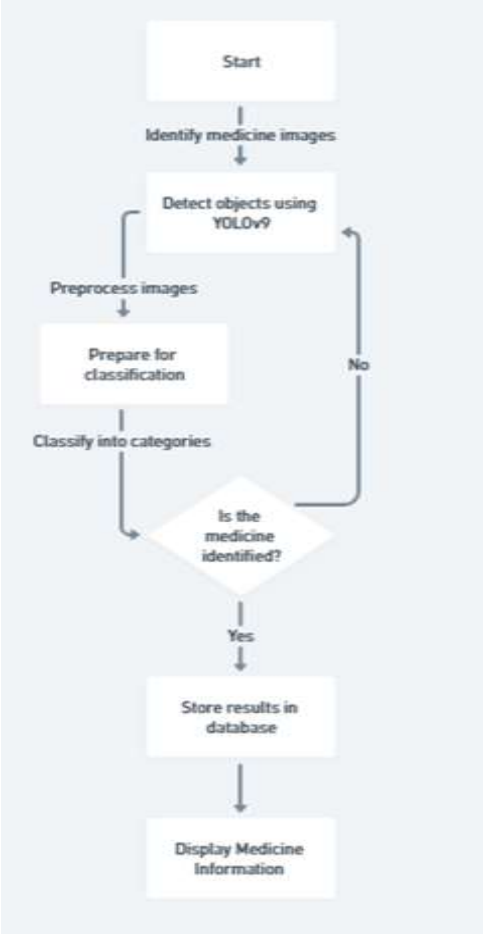

Fig 1. General Architecture of the Proposed Work

3.3 Implementation Details

3.3.1 Hardware Specification

Architecture is mainly framed for and All computer operating systems are designed for a particular computer architecture. The hardware requirements, min 16 GB or more RAM, 3.0 GHz of CPU, 64-bit Architecture, Intel core i7 or higher processor, Min 500 GB or more hard disk.

3.3.2 Software Specification

The software requirements are description of features and functionalities of the target system. The Coding Language we used is Python 3.7 or higher, Algorithms we used are YOLOv9 and CNN, Code Editor we used Visual Studio Code (VSCode), and some Python Libraries like NumPy, Pandas.

3.4 Methods

The medication identification device targets to robotically locate and classify drug treatments from images in their packaging. This section outlines the approach and strategies used to develop the device.

3.4.1 You Only Look Once Version 9 (YOLOv9)

YOLOv9 is chosen for its potential to carry out real-time item detection with excessive accuracy. The version is first-class-tuned to locate remedy packaging from images and draw bounding boxes around areas of interest. schooling YOLOv9: The annotated dataset is used to train the YOLOv9 version. during schooling, the version learns to locate and localize drug treatments within the picture. Loss capabilities used encompass category loss, localization loss (bounding box regression), and abjectness score (confidence of detection). Output: YOLOv9 outputs bounding boxes around detected drug treatments and labels them with the magnificence of the detected item (e.g., remedy packaging, label).

3.4.2 Convolutional Neural network (CNN)

After YOLOv9 detects the medication within the image, a Convolutional Neural network (CNN) is used to classify the detected images. The CNN is educated on classified images of numerous drug treatments. schooling CNN: The CNN is educated to understand extraordinary instructions of drug treatments based on their visible capabilities shade, shape, content patterns, and so on. Not unusual layers used within the CNN encompass convolutional layers (for characteristic extraction), pooling layers and absolutely connected layers (for category). Output: The CNN outputs the expected remedy magnificence and affords facts approximately the medication, which include call, dosage, and utilization commands.

4. Experimental Results and Discussion

- **Image Upload (Input Data):** The process begins when the user uploads an image of a medicine or its packaging. This image is the raw input data for the system.
- **Image Pre-processing:** Once the image is uploaded, it undergoes pre-processing. Pre-processing steps include resizing the image to fit the input size expected by the models (YOLOv9 and CNN) and normalizing the pixel values (scaling them between 0 and 1). Optionally, data augmentation techniques (like rotation, flipping, brightness adjustments) may be applied to enhance model performance. The pre-processed image is then passed to the YOLOv9 model for detection.
- **YOLOv9 Object Detection:** The pre-processed image is fed into the YOLOv9 model. YOLOv9 scans the image and identifies potential objects (in this case, medicine packaging or labels). It outputs a set of bounding boxes that localize the detected objects, along with confidence scores and class labels (to indicate the type of object detected, i.e., medicine packaging).
- **Bounding Box Extraction (Data Partitioning):** After the YOLOv9 model outputs bounding boxes, each detected region is cropped from the original image. These cropped sections contain the localized areas of interest (i.e., the medicines or packaging). Each cropped section serves as the input for the next step: classification.
- **CNN Classification:** The cropped image regions are passed individually to the CNN model. The CNN processes these images to classify the detected medicines. It extracts the key visual features from the image (like shape, colour, text patterns, etc.) and matches these features to the corresponding medicine categories. The CNN outputs the predicted class (medicine name or type) for each region, along with confidence scores for its predictions.
- **Information Output (Prediction):** Based on the CNN's classification, the system outputs detailed information about the identified medicine. This includes the medicine's name, dosage, usage instructions, and any other relevant data. The system also overlays the bounding box on the original image, visually marking where the medicine was detected.
- **User Interface (Output Data) :** The final data, consisting of the identified medicine information and the original image with bounding boxes, is displayed to the user via the interface. The user can view the medicine name, dosage, and any associated details directly on the interface. This data is the final output of the system.

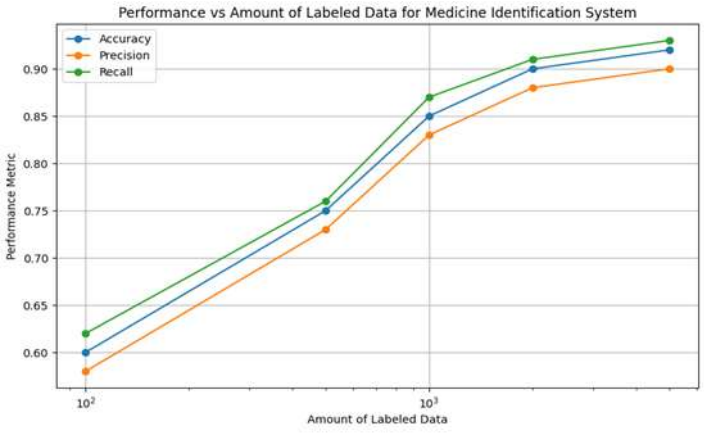

Fig 2. Graphical Representation of the obtained results

4.1 Results

Fig 3. Home page.

Fig 4. Registration page.

Fig 5. Choose a file.

Fig 6. Selecting of image file.

Fig 7. Choose a file for uploading

Fig 8. Output screen

5. Conclusion

In conclusion, the results of this project indicate that the Medicine Identification System utilizing YOLOv9 and CNN is a viable solution for reinforcing medication safety and efficiency in healthcare settings. The mixture of excessive accuracy, rapid processing, and resilience to various conditions positions this gadget as a valuable tool for healthcare providers. destiny paintings should consciousness on optimizing the model in addition, expanding the dataset, and refining user interactions to completely recognize the potential of this modern technique.

For future enhancements, several avenues warrant exploration. Expanding the system's database to encompass a broader spectrum of medications, including generics and less common drugs, will enhance its versatility. Improving the model's robustness against variations in packaging, lighting conditions, and label formats will further solidify its reliability in diverse environments. Incorporating real-time user feedback mechanisms could facilitate continuous learning and adaptation of the system, ensuring it remains up-to-date with new medications and regulatory changes.

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