Pill Detection and Medical Chatbot for Disease Prediction

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***Abstract*—In recent years, the convergence of advanced technologies, such as computer vision and natural language processing, has paved the way for innovative solutions in healthcare. This paper presents a novel framework that integrates pill detection and a medical chatbot to streamline the process of disease prediction. The pill detection system utilizes convolutional neural networks (CNNs) to analyze images captured by a smartphone or a dedicated device, providing real-time feedback on medication consumption. Simultaneously, a medical chatbot powered by natural language processing (NLP) engages users in interactive conversations to gather relevant health information. The collected data is processed by a machine learning model to predict potential diseases.**

***Index Terms*—Pill Detection,CNN,Decision Tree,Chatbot**

I. Introduction

In recent years, the intersection of healthcare and technology has witnessed a paradigm shift, with the integration of artificial intelligence (AI) and computer vision playing a pivotal role in revolutionizing traditional medical practices. This paper introduces an innovative approach that amalgamates pill de- tection and a medical chatbot to create a cohesive system for disease prediction and personalized healthcare. Adherence to prescribed medication regimens is a critical factor in effec- tive healthcare management. However, patient non-compliance remains a significant issue, leading to suboptimal treatment outcomes. To tackle this challenge, our proposed system employs advanced computer vision techniques, particularly convolutional neural networks (CNNs), to facilitate real-time pill detection. This not only ensures the authenticity of medica- tion but also provides patients with instant visual confirmation, fostering a sense of accountability in their treatment journey. Simultaneously, the integration of a medical chatbot pow- ered by natural language processing (NLP) offers a dynamic and user-friendly interface for patients to communicate their health-related information. By engaging users in interactive conversations, the chatbot collects valuable data regarding medication history, symptoms, and lifestyle factors. This infor- mation serves as input for a machine learning model designed to predict potential diseases or health risks, enabling proactive intervention and personalized healthcare recommendations.Pill detection using images is a rapidly developing area of research that has significant potential to revolutionize healthcare. The process of identifying pills based on their visual features is crucial for ensuring that patients receive the correct medica- tions, avoiding potential harm from incorrect medication, and identifying medications in a timely manner for emergency situations. Traditional methods of pill identification rely on manual inspection, which can be time-consuming and prone to error, particularly when identifying medications with similar physical characteristics. Recent advances in computer vision and machine learning techniques have led to the development of more accurate and efficient methods of pill detection using images. These methods are capable of identifying pills based

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on their unique visual features such as shape, colour, and markings. This has the potential to significantly improve patient care by automating the process of pill identification, reducing errors, and improving the speed and accuracy of diagnosis and treatment. As the demand for improved patient care and safety increases, there is a growing need for accurate and reliable methods of pill detection using images. With the help of machine learning and computer vision algorithms, we can expect to see further advancements in this area that can have a positive impact on patient outcomes and the healthcare industry.

II. Literature Survey

The paper [1] utilizes various artificial intelligence techniques such as Natural Language Processing, Natural Language Understanding, Natural Language Generation, and Automatic Speech Recognition. The proposed chatbot can be easily used by anyone who can type in their language on a desktop or mobile application. The chatbot provides personalized symptom analysis. However, it has some drawbacks such as the inability to recognize grammar mistakes, lower accuracy, and incapability to identify human emotions.

The author of the paper [2] has utilized the Google Net Inception Network as their primary classifier for detecting pill images. They trained three Google Net models with different specialties in color, shape, and features on an augmented dataset. Each model predicts the class and corresponding confidence score. The confidence scores from all three models are normalized using a customized SoftMax function at the end of each network, bringing them Pill Detection and Medical Chatbot for Disease Prediction within the range of 0 to 1. The proposed method can effectively detect pill images from a real dataset containing noise, different backgrounds, poor lighting conditions, various resolutions, and different points of view. However, the MAP score in the paper is relatively low.

The research paper [3] employs three machine learning models for classification, namely LSTM, Recurrent Neural Network, and Decision Tree. The chatbot is built using TensorFlow and NLP techniques to comprehend user queries and convert them into structured inputs. The chatbot can operate continuously, without any breaks, and provides quick responses to user queries, thereby saving time for both operators and users. Although the Decision Tree model is used, it has relatively low accuracy, and its time complexity is high.

The system in paper [4] comprises two stages: detection and classification. In the detection stage, drug-pill localization provides the location of pills. A deep convolutional neural network is utilized for feature extraction and feature pyramid construction, resulting in stronger semantics. Regression and classification models are improved to output the positions of the pills. In the second stage, drug pill classification is carried out using the pill positions output by the pills localization stage, and a deep convolutional neural network RCNN is employed to classify the pill types. The system has several advantages, including high accuracy,efficiency,scalability, and versatility. However, the model may fail to detect objects that suffer from motion blur or have low resolution, such as pills held in a hand.

The system in paper [5] includes two stages, detection and classification. In the detection stage, pills location is provided by drug-pill localization. The feature extraction and feature pyramid construction are performed using a deep convolutional neural network with stronger semantics. The position of the pills is output by improving the regression and classification models. In the second stage, drug pills classification is performed using the drug pills position output by the pills localization stage, and the pill types are classified using a deep convolutional neural network R-CNN. The advantages are High accuracy, efficiency, scalability, versatility. The model fails to detect object suffered from motion blur at low resolution as hand.

The model in paper [6] uses NLP for text-based pattern recognition and LSTM for making deep learning model. This bot offers medical-related information like doctor's contact details, address of nearby hospitals, contact details for getting an oxygen cylinder, about the disease, its symptoms, its prevalence, diagnosis, and its treatment procedures.

The system in paper [7] inquires for relevant particulars, e.g., name, age, etc. and appeals for symptoms. The bot can withdraw patterns from messages using AIML (Artificial Intelligence Mark-up Language) based on XML (Extensible Mark-up Language) to strengthen AI (Artificial Intelligence) applications. The structure asks progressively more specific questions in order to obtain a good diagnosis. It Engages patients in the conversation for their medical query and problems to provides an individualized diagnosis based on their diagnosed manifestation and profile. Medical chatbot can provide a somewhat accurate diagnosis to patients with simple symptom analysis and a conversational approach, this suggests that an effective spoken language medical bot could be viable. Moreover, the relative effectiveness of this bot indicates that more proceeds automated medical products may flourish to serve a bigger role in healthcare. This chatbot only answers the questions from a closed domain, or answer those questions, which are defined in the database. The accuracy is not satisfactory.

In paper [8], The UI gets the user query and after that sends it to the chatbot application. In the chatbot application, the literary experiences preprocessing steps incorporate tokenization where the words are tokenized, at that point the stop words are removed and feature extraction depends on ngram, TF- IDF, and cosine likeness. The question answers are stored in the knowledge database to recover the retrieve the answer. This chatbot is not intelligent (uses predefined conversation).

The [9] paper focuses on extracting pill image features to clas- sify different appearances of round pills. The experiment's re- sults indicate an accuracy rate of 0.922, making the round pill recognition system effective in assisting medical professionals to identify round pills and improve medical quality. The Model used is YOLO Deep learning model. The Advantages of this model are: 1. Effective recognition of pills with round shapes: The AY model is designed specifically to recognize pills with round shapes such as round-flat, round-convex, ellipsoid and sphere, which are difficult to recognize using traditional image recognition approaches. 2. Focus on feature extraction: The AY model is capable of mostly focusing on extracting the features of pill images to classify the appearance of different round pills. 3. High accuracy: The experiment results show that the accuracy rate of the AY model is 92.28indicating that the round pill recognition system can effectively assist medical professionals to identify round pills and improve medical quality. 4. Fast performance: The AY model is also reported to be fast in operation, although no specific speed was mentioned. But it has lower accuracy for small pill images.

The author in paper [10] has used the following models: Decision Tree, Classification and Regression Tree algorithm (CART) is used for attaining tree structure. The decision tree simply asks a question, and based on the answer Yes/No. Dimensionality Reduction includes feature selection, feature extraction. It is a Simple model and does Recommendation of the Doctor but user must reply in the format "YES/NO". No other format is accepted by the chatbot. The image processing techniques in paper [11] are used to extract shape and color features. Those features are used by Support Vector Machines (SVM) and Multilayer Perceptron (MLP) for classifying. The accuracy, Matthew's correlation coefficient, precision, and recall are used for the evaluation of the model. The model produces high accuracy. The paper discusses different approaches to feature extraction and classification, which provides insights into the comparative performance of these methods. The model is invariant to translation and rotation changes in the input images. The paper does not discuss the limitations of the proposed system, such as the types of pills it may not be able to classify accurately.

The paper [12] describes a study that proposes a smart tablet defect detection system based on the capsule neural network. The current method of detecting defective tablets by pharmaceutical manufacturers is limited to manual sampling, which has low efficiency, low reliability, and high cost. The capsule network provides effective technical support for non-destructive testing of tablets. The proposed system is fast, and the recognition accuracy rate is as high as 0.925 after 150 iterations. Even if the location, size, angle, and other factors of the entity are changed, the system can still identify the result accurately. Advantages: The capsule network-inverse rendering approach allows for the prediction of instance parameters of an image based on its rendering result, which is a departure from traditional machine learning approaches. Additionally, the capsule network has been shown to be effective in the proposed smart pill identification system, achieving good results with certain feasibility and value. Disadvantages: Too many software requirements.

The proposed models in paper [13] are based on i) a modification of the technique presented by Kasar, and ii) processing edge masks of imprints. The authors experimented with different thresholds for binarizing extracted text areas so that they could be used with optical character recognition (OCR). Advantages of the proposed approach include the ability to extract text information from pill images, which can be used to search for matching pills in existing databases. This can be a useful tool for both patients and pharmacists. The use of edge masks improves the accuracy of text extraction compared to other methods. The Otsu thresholding technique used in the study is a widely used and effective method for image binarization. One disadvantage of the proposed approach is that it may not work well with pill images that are over/under-exposed or have multiple-colour backgrounds. Engraved imprints on tablet pills are also difficult to extract because the colours of imprints and background are very similar and the colour of a character is not uniform. Therefore, the approach may need further improvement to be effective in such cases.

The proposed method in the paper [14] uses image processing techniques to segment the foreground and background regions of a pill image and isolate the text imprint within the foreground region. The steps involved in the method include pre-processing, segmentation, and recognition. The pre-processing step involves resizing the image and converting it to grayscale. The segmentation step involves segmenting the foreground and background regions using a combination of colour threshold- ing and edge detection. The recognition step involves using optical character recognition (OCR) to recognize the text imprint within the foreground region. The proposed method is automatic, which can save time and effort compared to manual methods. The method achieves high accuracy rate of 0.924 in text imprint recognition. The method outperforms two other state-of-the-art methods. The method can be useful in pharmaceutical applications, such as pill identification and quality control, as well as in forensic investigations where pill identification is important. The method relies on OCR, which may not work well for certain types of text or font styles. The method may not work well for pill images with complex backgrounds or lighting conditions. The method may not work well for images with low resolution or poor quality.

The text extraction in paper [15] is done using Natural Language Processing. KNN identifies the symptoms from the interaction with the user. KNN maps the symptoms to the disease and finally recommends the suitable treatment to the user. It is Easier to access since it is a mobile based application. It is User friendly. Could have tried to compare the current model with other models.

III. Methodology

When users are using the application for the first time, they will need to register by providing their login details, which will then be sent to the database for storage. The user enters their login details, which are verified using the database to ensure correctness. There are two options to choose from, Firstly, the user is prompted to input an image. After the image is received, it undergoes processing to extract features. The processed data is then applied to a trained masked 3-layer CNN model, which evaluates the image to generate an output. Second, the user is asked to input their symptoms, which uses Decision Tree for evaluation . After processing, the data is evaluated using a well-trained model to generate a disease name as the result.then the chatbot will recommend nearby doctors

A. Pill Detection

The Pill Detection establishes an image classification model for identifying different types of pills using TensorFlow and Keras. It begins by setting parameters such as the number of classes and image dimensions. The model architecture comprises convolutional and max-pooling layers for feature extraction, followed by flattening and dense layers for classification. Pretrained weights from a saved model file are loaded. The detectpillfromimg function takes an image file as input, preprocesses it, and utilizes the trained model to predict the pill type with associated confidence. The result is printed, indicating the most likely pill class. The code demonstrates a practical methodology for pill identification through deep learning, allowing users to assess pills from images.

B. Disease Prediction

A decision tree classifier is trained on medical symptom data to predict potential diseases based on user-input symptoms. The model considers symptom severity, descriptions, and pre- cautions. The Flask web framework is utilized for creating an API endpoint to handle user input and provide health analysis results.It also involves using the Google Maps API to retrieve specialist doctors based on the predicted disease and the user's location. The retrieved doctors' names, addresses, and ratings are then displayed.

IV. Results

The accuracy of Pill Detection is 81.84The accuracy of Disease Prediction is 97.61

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