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VIRTUAL SMART ASSISTANT FOR VISUALLY CHALLENGED PEOPLE FOR EMPOWERING INDEPENDENCE

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ABSTRACT

The Vision-Med: Virtual Assistant for Visually challenged is an application that assists visually impaired individuals in identifying their medications and ensuring their safety by preventing the consumption of expired drugs. The threat of expired drugs is a significant concern for visually impaired individuals who have difficulty reading the expiry date and name of the medicine on pharmaceutical packaging. Visually challenged individuals may require the assistance of a third person to help them with their medication every time. Expired drugs can lose their potency and effectiveness, leading to adverse reactions and health complications. For visually impaired individuals, the inability to read the expiration date of the medication can lead to confusion and medication errors. This occurs when a person accidentally consumes an expired drug, potentially leading to adverse health effects. The cost of replacing expired medication can be substantial, placing additional financial hardship on patients. The Vision Med application provides audio feedback to the user about the name and expiration date of the medication which leads to reducing the use of tablets that have expired. The application leverages Computer Vision (CV), Natural Language Processing (NLP) techniques, and Text to Speech (TTS) conversion to recognize medicine names and expiration dates from images of medication packaging. It provides audio feedback to the user about the medicine's name and expiration date, improving medication adherence and enhancing the independence of visually impaired individuals. The Vision-Med application is a game changer for visually impaired individuals who struggle with medication management, thereby promoting safe medication and independent living. The performance of the application is evaluated with an accuracy of 98%.
Keywords: TTS, NLP, Audio Labelling, OCR, Speech Conversion

MOTIVATION

At present, globally, at least 2.2 billion people all over the world have a vision impairment. The statistical data of World Health Organization says that about 10 percent of the world's population is differently abled and 80 percent of this estimation lives in developing nations. In a developing country like India around 26.8 million people are

differently abled. In this population around 50 percent of the differently abled people are identified with vision problems which top the list. Reading plays a significant role in our day-to-day life. Information is present everywhere in the form of text and/or image in magazines, newspapers, Bank documents, etc. But, the text in medicines should be given at most care while buying and consuming to ensure the correctness and validity period. It is a very easy task for the normal people but very difficult for the visually challenged. This proposal is a result of an insight to the most common challenge faced by visually impaired and proposes the small, efficient and intelligent system named "Virtual Assistant for Visually challenged" with the aim to be utilized by the community of vision impaired. The proposed automatic assistant system like mobile app and the embedded system will scan the medicine, take the picture, analyze the image and use the intelligent learning and recognition algorithms to extract the required information and convert the text to speech making it available to the user in the form of audio. The features of interest are labels in the medicine and the expiry date. Those features are extracted, analyzed, recognized and produced in audio format of label and expiry date. Such an assistive model enables the visually challenged to take the right medicine as prescribed by doctor when they need to consume more tablets periodically and allows them to lead the life independently.

LITERATURE SURVEY

Most of the systems currently in use detects the expiration date of the medicine using the barcode present in the medication packaging. The barcode text extraction system extracts information such as expiration dates. Users can also capture a photo of the medicine and manually input the details using the phone's keyboard. Optical Character Recognition (OCR) technology can be used in Android applications to detect medical information such as the name and expiry date. A pill detection model is a machine learning algorithm designed to detect the expiry date of medication based on an image of the pill packaging.

The model can be trained using a dataset of pill packaging images with their corresponding expiration dates, allowing the algorithm to learn patterns in the images that correlate with expiration dates.The main drawback of this system is that it cannot be used by people who are visually challenged. Another system is an Audio Labeling Device that speaks out information about the medication, such as the expiration date. But it costs a lot of money to do this task.

EXPIRY DATE DETECTION USING BARCODE

[Padmapriya, Mrs. V. et al. "Expiry Date and Cost Tracking in Medicine for Visually Impaired." 2020.]

The effects of consuming expired products, particularly medicines, include deterioration of patient health, side effects, and death in some people. It helps users to identify their medicines by scanning the barcodes found on the medication packaging [6]. The items have barcodes that allow pharmacies to detect the price of the medicine. It provides information about a product when the barcode is scanned. The use of an expired product may be harmful to the users. The Medicine industry has always played an important role in the development of the nation. But various studies have suggested that there is a lack of knowledge among the common people about prescribed medicines (usage, dosage, precautions, and side effects). Thus, displaying such information through a mobile-based application will be very helpful. There are many types of barcode systems available.

AUDIO LABELING DEVICE

[Andrey Yeryomenko, Rachele Aleida March, Hermann Hoth, Eva Brown.Audio Labeling Device for expiry date detection, Hamburg, May 2021.]

The Audio Labeling Device for expiry date detection is a portable and easy-to-use tool designed to assist visually impaired individuals in identifying the expiry date on

medication packaging. The use of an expired product may cause harm to its designated target. If the product is for human consumption, e.g., medicine, the result can be fatal. While most people can easily check the expiration date before using the product, it is very difficult for a visually impaired or totally blind person to do so independently.

PILL DETECTION MODEL
[Kwon, Hyuk-Ju & Kim, Hwi-Gang & Lee, Sung-Hak. (2021). Pill Detection Model for Medicine Inspection Based on Deep Learning. Chemosensors.]

A pill detection model is a machine learning algorithm designed to detect the expiry date of medication based on an image of the pill packaging. The model can be trained using a dataset of pill packaging images with their corresponding expiration dates, allowing the algorithm to learn patterns in the images that correlate with expiration dates. The model's accuracy can be improved by using more advanced techniques, such as deep learning, which involves training a neural network to recognize patterns in the images [5]. This approach can achieve higher accuracy by learning more complex patterns in the images that correspond to expiration dates.

INFERENCE ON EXISTING SYSTEM

The barcode on the product may be of poor quality or may be distorted, leading to inaccurate or incomplete data capture. Not all medication packaging comes with a barcode, and there can be inconsistencies in the way barcodes are formatted and placed on the packaging. The application may require a specific type of barcode reader to function properly, which may be expensive or difficult to access for some users, limiting the availability of the technology. The expiration date of the medicine is the only information that can be obtained from the barcode, and additional information, such as dosage instructions, contraindications, and drug interactions, may not be available through this technology.

ALD (Audio Labeling Device) can be expensive and may require some technical expertise to use effectively. The device may have limitations in its ability to attach to certain medication containers or packaging, such as blister packs or uniquely shaped containers, which may limit its overall effectiveness. The device may encounter technical issues, such as malfunctioning or inaccurate readings due to sound interference or microphone limitations, which could result in the incorrect identification of medication. The device may only support certain languages, limiting its effectiveness for users who speak different languages. Post-OCR is an important processing step that follows the Optical Character Recognition (OCR) and is meant to improve the quality of OCR documents by detecting and correcting residual errors. It describes the results of a statistical analysis of OCR errors on four document collections.

To deal with the above problems, a Vision-med system is proposed. It is cost-effective and has the ability to detect the image of medicine and provide the medicine's name and expiration date all at once as an audio output using the text-to-speech module. The accuracy of the device is higher because of the use of the cloud service for extraction of the information and manually processed the information to get the name and expiration date. This application is more beneficial for visually impaired individuals.

PROJECT DESCRIPTION

The Vision-Med (Virtual Assistant for Visually challenged) is an application that assists visually impaired individuals in identifying their medications and ensuring their safety by preventing the consumption of expired drugs. The threat of expired drugs is a significant concern for visually impaired individuals who have difficulty reading the expiry date and name of the medicine on pharmaceutical packaging. Visually challenged individuals may

require the assistance of a third person to help them with their medication every time. Expired drugs can lose their potency and effectiveness, leading to adverse reactions and health complications. For visually impaired individuals, the inability to read the expiration date of the medication can lead to confusion and medication errors. This occurs when a person accidentally consumes an expired drug, potentially leading to adverse health effects. The cost of replacing expired medication can be substantial, placing additional financial hardship on patients. The Vision Med application provides audio feedback to the user about the name and expiration date of the medication which leads to reducing the use of tablets that have expired. The application leverages Computer Vision (CV), Natural Language Processing (NLP) techniques, and Text to Speech (TTS) conversion to recognize medicine names and expiration dates from images of medication packaging.

It provides audio feedback to the user about the medicine's name and expiration date, improving medication adherence and enhancing the independence of visually impaired individuals. The Vision-Med application is a game changer for visually impaired individuals who struggle with medication management, thereby promoting safe medication and independent living. The performance of the application is evaluated with an accuracy of 98%.

Vision-Med is an application that uses advanced image recognition technology to identify medications and determine their expiration dates. This enables users to take a photo of their medication using the camera feature. Once the image is analyzed, the app provides audio output that includes comprehensive details about the drug, such as its name and expiration date. It aims to provide information to the visually impaired individual using an open-source library and cloud service. Vision Med makes use of Microsoft Azure OCR (Optical Character Recognition), which transforms an image of text into a machine-readable text format. NLP (Natural Language Processing), which analyzes the text, is then used to extract pertinent information from it, such as the name, dosage, and expiration date of the medication. TTS (Text-To-Speech) is a very well-liked forceful technology that reads words to the user. The user can receive audio output thanks to this module.

The Vision-Med application is a groundbreaking tool that addresses a significant concern for visually impaired individuals, promoting safe medication management and improving overall quality of life. This application is a reliable and user-friendly system that can assist visually impaired individuals in detecting the expiry date of medicines accurately. It is an excellent example of how technology can be leveraged to promote inclusivity and improve the lives of individuals with disabilities.

WORKFLOW OF VISION MED

The user inputs an image of a medicine by capturing it using the camera feature in the mobile application. The visually challenged user uploads the image of the medicine in the corresponding application. The initial step involved in the model is data acquisition. Data has been gathered from several heterogeneous sources. The collected data is mapped to the image given as input. Using the predefined dataset, it extracts the name of the medicine. The uploaded image is segmented to clearly extract the image of the expiry date, which is present in blue or black coloured ink. Microsoft Azure provides a service called Optical Character Recognition (OCR)that converts the image of text into machine-readable text format. It extracts text from the image (medicine), which includes the medicine's name, and expiration date.
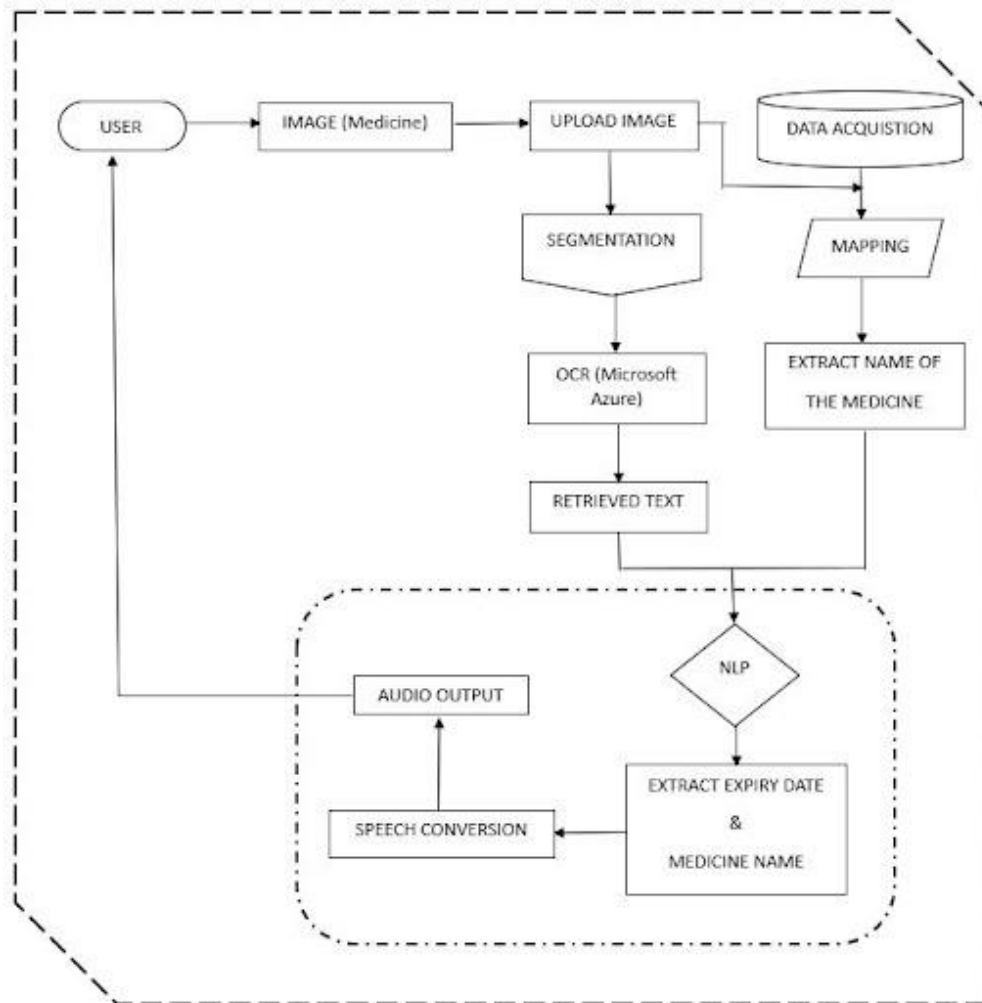
Fig.1 Virtual Assistant for Visually Challenged

The extracted expiry date and name of the medicine are processed using NLP (Natural Language Processing) which interprets the text and extracts the relevant information from the text including the medicine name, dosage, and expiry date. Python Flask is used to build the application by utilizing machine learning models to detect expiry dates of products from images uploaded by users. This app can take in the image and process it using the machine learning model, and then display the expiry date back to the user, as mentioned in the Figure 3.4. Flutter is used as a frontend tool for designing mobile applications, with an integrated function such as text-to-speech plugins. The working principle of the proposed Virtual Assistant for Visually Challenged is shown in Fig.1 above.

The extracted text is converted into speech using TTS(Text-To-Speech) technology that allows developers to integrate text-to-speech functionality into their Flutter applications. This module helps in providing audio output to the user. The performance is evaluated with an accuracy of 98%. The Vision Med application provides audio feedback to the user about the medicine's name and expiration date, improving medication adherence and enhancing the independence of visually impaired individuals.

The Vision Med application provides audio feedback to the user about the medicine's name and expiration date, improving medication adherence and enhancing the independence of visually impaired individuals. The Vision-Med application is a game changer for visually

impaired individuals who struggle with medication management, thereby promoting safe medication and independent living.

➢ Vision-Med is a game-changer for visually impaired individuals who struggle with medication management.
➢ It assists users in avoiding taking out-of-date medications, which could have detrimental effects on their health.
➢ The application provides a sense of ease and reduces the stress associated with managing medication.
➢ It promotes independence for visually impaired individuals and improves adherence to medication.
➢ It is a cost-effective solution that helps avoid the financial burden of replacing expired medication.

SYSTEM ARCHITECTURE

The architecture of the proposed work is given in Fig.2 below. The user inputs image of a medicine by capturing it using camera feature in the mobile application. The visually impaired person uploads the image of medicine in the mobile application.The initial step involved in the model is data acquisition, data has been gathered from several heterogeneous sources. The collected data is mapped to the image given as input. Open CV is used for feature extraction which is used to recognize the text on medicine packaging through image processing and segmentation.

The image is segmented to clearly extract the image of the expiry date which is present in blue or black colored ink. The Microsoft Azure provides a service called Optical Character Recognition (OCR) that converts the image of text into machine-readable text format. It extracts text from the image (medicine), which includes the medicine name and expiration date.
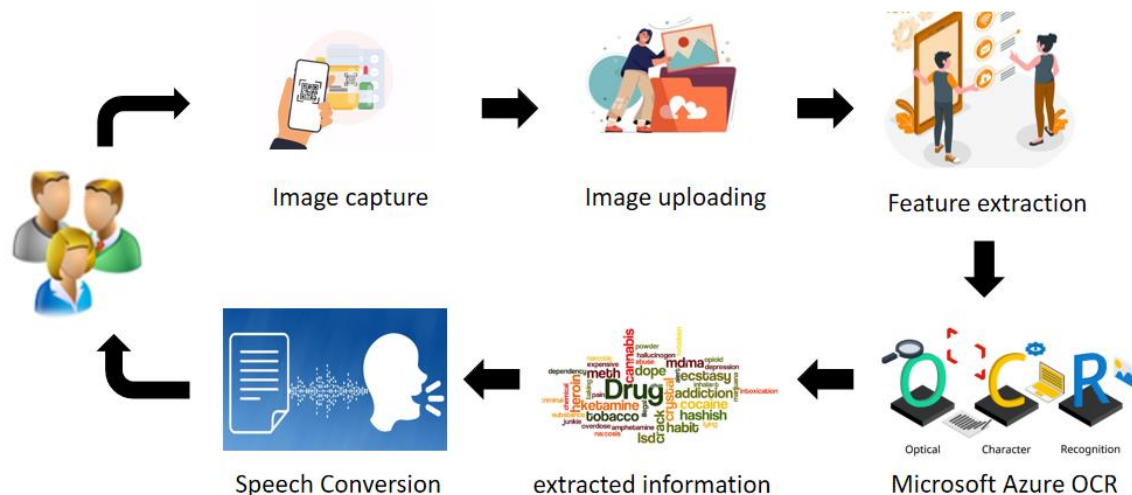

Fig.2 System Architecture

The application also includes a database module that stores the medication information, such as name and expiry date, for future reference. The database module also stores the user's medication history, allowing them to track their medication adherence. The application runs on a mobile platform and leverages cloud-based services, such as Microsoft Azure, for OCR and speech synthesis.

Python Flask is used to build the application by utilizing machine learning models to detect expiry dates of products from images uploaded by users. This app can take in the image and process it using the machine learning model, and then display the expiry date back

to the user, as mentioned in Figure 5.1. Flutter is used as a frontend tool for designing mobile applications, with an integrated function such as text-to-speech plugins. The extracted text is converted into speech using TTS(Text-To-Speech) technology that allows developers to integrate text-to-speech functionality into their Flutter applications. This module helps in providing audio output to the user. With Flutter TTS, developers can easily convert text to speech in various languages and adjust the speech rate, pitch, and volume. The application provides audio output to the user.

The beneficiaries of this application are visually challenged individuals who have difficulty reading small text or identifying different shades of colors. The primary advantage of Vision-Med is that it helps in preventing the consumption of expired medication, which could lead to adverse health effects. This application is also cost-effective as it reduces the need for replacing expired medication, which can be a financial burden for patients. Additionally, Vision-Med promotes independent living by allowing visually impaired individuals to manage their medication without the assistance of others.

IOT ARCHITECTURE

Vision-Med uses a combination of Raspberry Pi and IoT devices to detect the expiry date of medications. The camera module on the Raspberry Pi captures the image of the medication packaging. The image is then processed by the Vision-Med software to extract the expiry date and medication name using Optical Character Recognition (OCR) and Natural Language Processing (NLP) techniques.To ensure that the Raspberry Pi and camera module receive power, a power adapter is used. This provides a stable source of power to the devices, preventing any potential issues related to power fluctuations, as mentioned in Figure. 3. The push button is used to initiate the image capture process. The user simply needs to press the button, and the camera module captures an image of the medication packaging.

The image is then processed using the Vision-Med software, which extracts the expiry date and medication name. The user is then provided with an audio output that informs them of the medication name and expiry date. This system ensures that visually impaired individuals can easily and accurately determine the expiry date of their medications, which is crucial in ensuring medication safety and efficacy.

Fig.3 IoT Model of Vision MED APP

MODULE DESCRIPTION:

The Vision - Med application combines a number of modules, including text-to-speech, natural language processing, Microsoft Azure OCR, and user interface, to offer visually impaired people a comprehensive solution. By using these technologies, the application may assist users with reading pharmaceutical labels, keeping track of their medication regimens, and autonomously managing their prescriptions. Additionally, the user interface of the application is user-friendly and accessible, making it simple for those who are visually impaired to interact with the application. Thus, the application improves the day-to-day activities of visually impaired individuals.

USER INTERFACE MODULE

The user interface of the Vision Med application is designed to be accessible to individuals with visual impairments as mentioned in the Figure 4. Here are some of the user interface components:
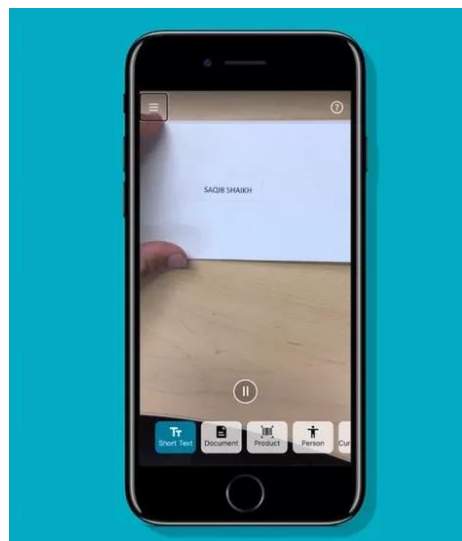

Fig.4User Interface Design

- ➢ Screen reader compatibility: The application should be compatible with screen readers, which are software programs that read the content of the screen aloud.
- ➢ Text-to-speech support: The application should have support for text-to-speech technology, which allows the application to read text aloud to the user.
- ➢ Large text size and high contrast: The text displayed on the application should be large and high contrast to make it easier for visually impaired users to read.
- ➢ Use of color: The application should avoid using color alone to convey information, as this can make it difficult for users with color blindness to understand the content.
- ➢ Simple navigation: The application should have a simple and intuitive navigation system that is easy for visually impaired users to understand and use.
- ➢ Audio feedback: The application should provide audio feedback to the user, such as sounds or voice prompts, to indicate actions or changes in the application.
- ➢ Braille support: The application should have support for Braille displays, which can provide tactile feedback to visually impaired users.

TEXT EXTRACTION MODULE

Microsoft Azure OCR (Optical Character Recognition) is a cloud-based service offered by Microsoft Azure that allows developers to extract text from images and documents. The service uses advanced algorithms and machine learning models to accurately

recognize and extract text from a wide range of sources, including scanned documents, images, and PDF files.

Azure OCR supports multiple languages and character sets and provides developers with a range of tools and APIs for integrating OCR functionality into their applications. With Azure OCR, as mentioned in the Figure. 5developers can quickly and easily extract text from documents and images and use it to automate data entry, improve search functionality, and more.

Fig.5Text Extraction Sample

TEXT TO SPEECH MODULE

Text-to-speech (TTS) is a technology that converts written text into spoken words. It is a type of assistive technology that can help people with visual impairments, learning disabilities, or other conditions that make reading difficult or impossible. TTS systems can be used in various applications such as virtual assistants, navigation systems, audiobooks, and more.

The process of text-to-speech involves three main components: text analysis, linguistic analysis, and speech synthesis. In the text analysis stage, the input text is analyzed for punctuation, capitalization, and other formatting issues. In the linguistic analysis stage, the text is broken down into phonemes, as mentioned in the Figure 6which are the smallest units of sound in a language. Finally, in the speech synthesis stage, the phonemes are combined to produce natural-sounding speech.
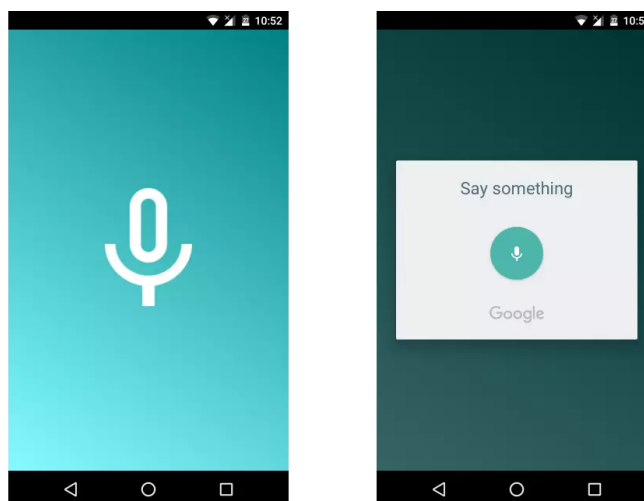
Fig.6 Text-to-Speech Module.

CONCLUSION

Vision-Med ideology has become one of the major topics for researchers with much consideration to the accuracy and authenticity of the data. Even though various systems have been proposed to assist visually impaired individuals in detecting obstacles and providing smart shopping assistance, no device has been developed to find expiration details without the support of a third person. Hence, Vision Med helps detect expired drugs, which can help avoid several health consequences. The application assists visually impaired individuals in identifying their medication and ensures their safety by preventing the consumption of expired drugs, thereby improving their independence and quality of life. The application has achieved an accuracy rate of 98%.

FUTURE WORK

➢ In the future, the application may also include drug information such as dosage, side effects, and usage instructions.
➢ It will be helpful in detecting counterfeit drugs, which pose a severe threat to public health and can have serious effects.
➢ Integration with Wearable Devices: Expiry date detection might be combined with wearable devices to offer real-time warnings and reminders as wearable devices become increasingly widespread in healthcare.

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