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A Compressive Review of Machine Learning Approaches for Drug Pill Identification for Visually Impaired Patients

Sanjay A. Agrawal[1], Dr. Shital S. Agrawal[2], Dr.Yogendra Patil[3], Dr. Swapnil Chaudhari[4], Tejaswini S. Bhoye [5], Nidhee S. Agrawal[6]

1,5 Asst.Prof. and 3,4 Asso. Prof. of Dept. of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology, SPPU, Pune,Maharashtra, India.

2Asso.Prof. of B. R. Harne College of Engineering & Technology, Vangani, Mumbai, Maharashtra, India.

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Machine learning, Image collection, Pill characterization

ABSTRACT:

Machine learning (ML) is a subset of artificial intelligence (AI) in which we train a model in such a way that it becomes capable of making predictions when we feed it with suitable processed data. Loss of faculties like hearing, motor skills, vision, memory, etc. is a common part of the aging process for humans. These losses can make it difficult for elderly people to perform ordinary everyday tasks, which frequently puts them in danger. To be specific, one of the biggest hazards is linked to the incorrect use of prescribed medication or forgetting to take it, which can seriously endanger the health and life of seniors. Additionally, the existing solutions to this issue are made for everyone and do not take into account the unique requirements of senior citizens. The first steps of a broader, specifically designed toolkit for elders are being developed and will be presented in order to address this lack of support. The suggested methods include image collection and pill characterization based on its shape, dimensions, and color. This information is used to train our system. Later, in the recognition step, the input information from the user is used to compare against the prior information to produce the user with relevant data.

1. Introduction

People may suffer a reduction in their visual and cognitive capacities as they age. Because they may find it difficult to remember crucial information and navigate their surroundings, older folks may become more susceptible to risky situations. Usually, it is taken in addition to medication. The improper or frequent forgetfulness of elder drug use can have a major negative impact on an individual's health. On the other hand, realizing this can make someone feel less confident, which makes them need assistance to change this scenario. It is unlikely that the healthcare system will offer the assistance seniors with visual impairments need to accurately identify and take their medications. Generally, elderly individuals with visual impairments are prone to a higher likelihood of medication errors and medication non-adherence.

The study further indicated that these issues are prevalent among this demographic. Consequently, the anticipated consequences of medication errors in visually impaired patients are substantial in terms of medical costs, and these individuals may face challenges in accessing adequate support in managing their medications. A smaller, computer vision-based version of the larger elderly care tool has been created as a solution to this problem. The goal of this mobile device tool is to help elders identify medications, thereby increasing their confidence and independence. The study emphasized how patients with impaired vision may suffer significant medical losses as a result of drug errors, and how difficult it may be for them to get the help they need. The suggested solution intends to address this issue by creating a pill identification technique tailored to people with long-term visual impairments, assisting in their safe medication administration.

2. Literature Survey

Several researchers have introduced different approaches to tackle this problem, and a few of these methods are discussed in this section. Several tools have been developed and assessed to assist in the safe utilization of medication, such as medication reminders and pill recognition capabilities. Accurate identification of pills

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is crucial for patient safety and care. In this article, the recognition and characterization descriptors of pills are analyzed by utilizing the National Library of Medicine (NLM) pill database, which has been recently published. The research paper details the investigation of algorithms designed to automatically divide images of pills from the National Library of Medicine (NLM), while also extracting various features.. The objective was to group pills based on priority, in accordance with the physical properties recommended by the FDA. [1]

The National Library of Medicine in the United States launched a competition in January 2016 to develop high-quality algorithms and software capable of accurately comparing consumer prescription pill images with those in the authoritative collection. The main objective of competition developing an algorithm to identify unknown prescription pills for healthcare professionals as well as the general public. Being able to verify pills in scenarios where documentation and medication have been separated, along with image information, can offer considerable advantages. In this context, this paper explores various descriptors for pill detection and characterization, with an emphasis on investigating algorithms for automatically segmenting NLM pill images and extracting several features to group pills based on the priorities of authoritative recommendations for pill physical attributes. [2]

Calix et al. [3] paper investigates the usage of various machine learning algorithms, especially deep learning ones that create classifiers that can identify personal experience tweets (PETs). Furthermore, it presents and examines a method called Deep Granulator that seeks to improve the analysis outcomes [3]. One of the main components of health surveillance, which monitors situations that could have an impact on people's health, is pharmacovigilance. Pharmacovigilance keeps track of and oversees the responsible use of pharmaceutical drugs. Twitter data can be used for this endeavour since users share their own health-related experiences online. Nevertheless, one problem with Twitter data is its high noise content. Thus, a noise-cancelling plan is needed. In this study, deep neural networks (PETs) and other machine learning methods are used to develop classifiers The planning process works in two different ways. The first type is to create and save the tablet profile, the first is to capture the image containing the characters and the tablet. Buying photos will take photos from the site and that can help detect these Personal Experience Tweets. Lastly, author propose the Deep Granulator, an approach that improves result [3].

The system comprises four elements: an intelligent drug recognition device, an Android mobile application, a training server built on deep learning models, and a cloud-based management platform. Currently, the system can detect 80 different types of drugs. [5]

To demonstrate the feasibility of the service concept, an initial prototype called Blind NFC was created. This prototype featured an NFC-enabled PDA that could audibly announce the medication name and dosage information upon contact with the medication package. The study's results indicated that older users could readily comprehend and use the touch- and audio-based system's essential features.[4]

Zeng et al. [10] proposed the MoblieDeepPill, which used the Histogram of Oriented Gradient and Support Vector Machines (SVMs) for single drug localisation and the multi-CNN models were applied to collect pill characteristics. Wang et al. [11] used three GoogLeNet Inception models with different effects on the colour, shape, and feature, and decision fusion was used to combine those models. However, in [11], the positions of pill images were limited to rotations by 90°, 180°, and 270°. In the practical applications of a drug pill detection system, the aforementioned studies would have issues requiring further development, such as the determination of randomly positioned and rotated pills, as well as the number of pills in each detection task.

Urja Patel et al. [13] paper reviews various methods to analyse pharmaceutical tablets specifically in non-clustered environments. The machine learning techniques analysed here aim to inspect and identify them based on various parameters. The paper compares deep learning and machine learning techniques in the current state-of-art. The methods analyzed find application in the tablet production industry, drug identification by customers and packaging industry.

3. System Architecture

resize them to the correct dimensions. When a mark is detected, the system identifies the tablet by examining its shape, size and color and stores all relevant information in a file for future reference. The experimental type focused on the identification of drugs using tablets and water filters. Test mode first takes the image and modifies the image similar to training mode. After detecting the signal, the system distributes the medicine and performs the filtering function. After guessing the image, the system searches the database for matching images. Finally, the additive is the color decision that supports the use of the color filter. This process can result in three types of results: no drug detected, one pill detected, or multiple drugs detected. Select dimension to filter the existing solution by its dimensions and heights. The remaining pellets are then color tested using a color filter. This process can produce one of three results: no drug detected, one pill detected, or more than one drug detected. The capsule initially goes into the training phase to be further developed. The tablet is scanned using the phone's hardware; that is, the camera captures and trains the tablet for precise analysis; Here is the first block from the image that captures the image of the tablet for training accordingly. In the second stage, size normalization determines the size of the tablet according to the specified criteria and removes all background from the captured image. For this process, a smart edge detection algorithm is used to reduce the area of the captured tablet. In symbol detection, the optical symbol algorithm is used to identify the symbol and then the current pattern of the drug is determined according to the properties of the core drug. The comparison is made and then, with the help of SIFT, the algorithm determines the number pi. Once a tablet is identified, it is stored as a user ID in the database. After tablet training, the test mode is done in the same way.

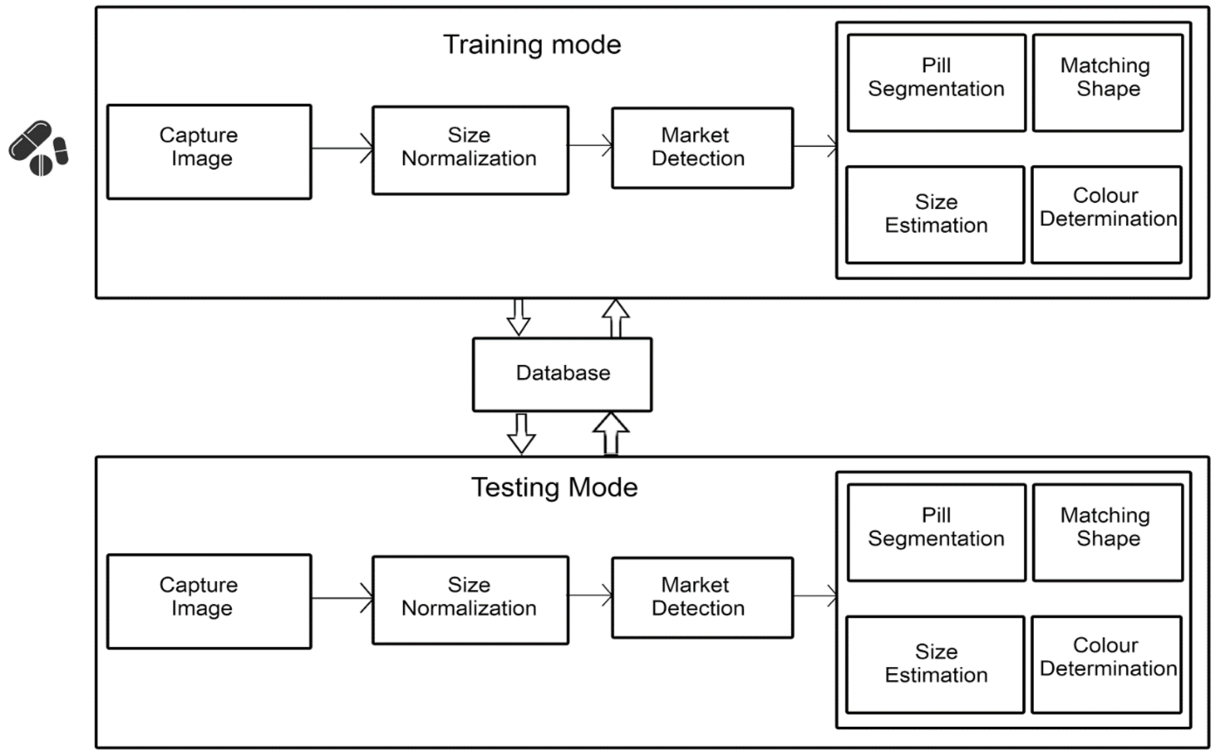

Figure No. 1 : System Architecture

4. Algorithm

Scale-Invariant Feature Transform (SIFT):

The SIFT algorithm consists of four main steps:

- Selecting a scaled peak in the space used for the potential feature search position.
- Key point localization is the process of accurately determining the location of a function's key points.
- Orientation assignment involves assigning an orientation to these key points. A multidimensional vector represents the key point descriptor.

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- Key point matching is then employed to match key points between two images by identifying their closest neighbors. An example of this is the scale-invariant method used to locate key points that are invariant to scale and rotation

Working of SIFT Algorithm:

Step 1: Firstly, it starts with data points that are assigned to the drug pill.

Step 2: The algorithm will now compute the points.

Step 3: The algorithm classifies the key points.

Step 4: The process is iterated and moved to the next identification

Step 5: Lastly, the key points are matched between the two images.

Canny Edge Detection:

Canny edge detector is a very popular edge detection method. It uses various algorithms to identify the edges of the image. Use Gaussian to reduce the effect of noise in the image. The procedure then involves removing the largest non-gradient pixels, reducing the potential edge to a 1-pixel curve.[7]

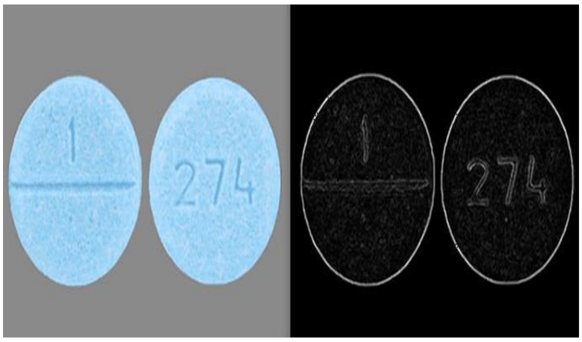

Figure 2: Canny Edge Detection

Optical Character Recognition (OCR):

Optical Character Recognition uses optical patterns in digital images. It is done through steps such as character recognition, sentence segmentation, feature extraction and classification. The basic steps in the OCR process are:

The first step is to remove border characters from the image.

Create a convolutional neural network (ConvNet) to store image symbols.

Load the trained model Convolutional Neural Network (ConvNet).

ConvNet predictive signal optimization. For example: Use the OCR algorithm to generate the characters of the drug.

Figure 3: OCR

Text to Speech:

This algorithm uses text-to-speech techniques to generate audio output from text input. This model takes notes and completes it through several stages or blocks until it turns into sound.

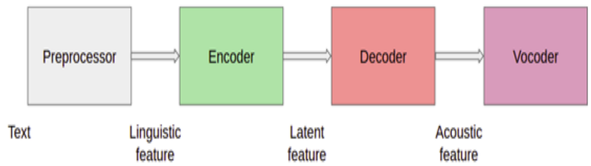

Figure 5: Text to Speech

Conclusion

For visually challenged individuals with chronic illnesses, we have presented a machine learning-based medicine pill recognition system. The guidelines are designed to facilitate medication adherence and include cloud-based data management, mobile app, and machine learning (ML)-based smart medication dashboard

The suggested method uploads medication data to a cloud-based management platform to create medication use records, enabling family members or cares to check on the status of a patient's medications for a chronic illness if they have visual impairments via a smartphone app. The danger of drug hazards brought on by taking the improper medication can be considerably decreased by using the mobile app to track the medication status of elderly or visually impaired chronically ill patients. Thus, the suggested approach can efficiently reduce the issue of drug interactions brought on by taking the wrong

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medication, thereby lowering the expense of medical care and offering a secure pharmaceutical environment to chronic visually impaired patients.

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