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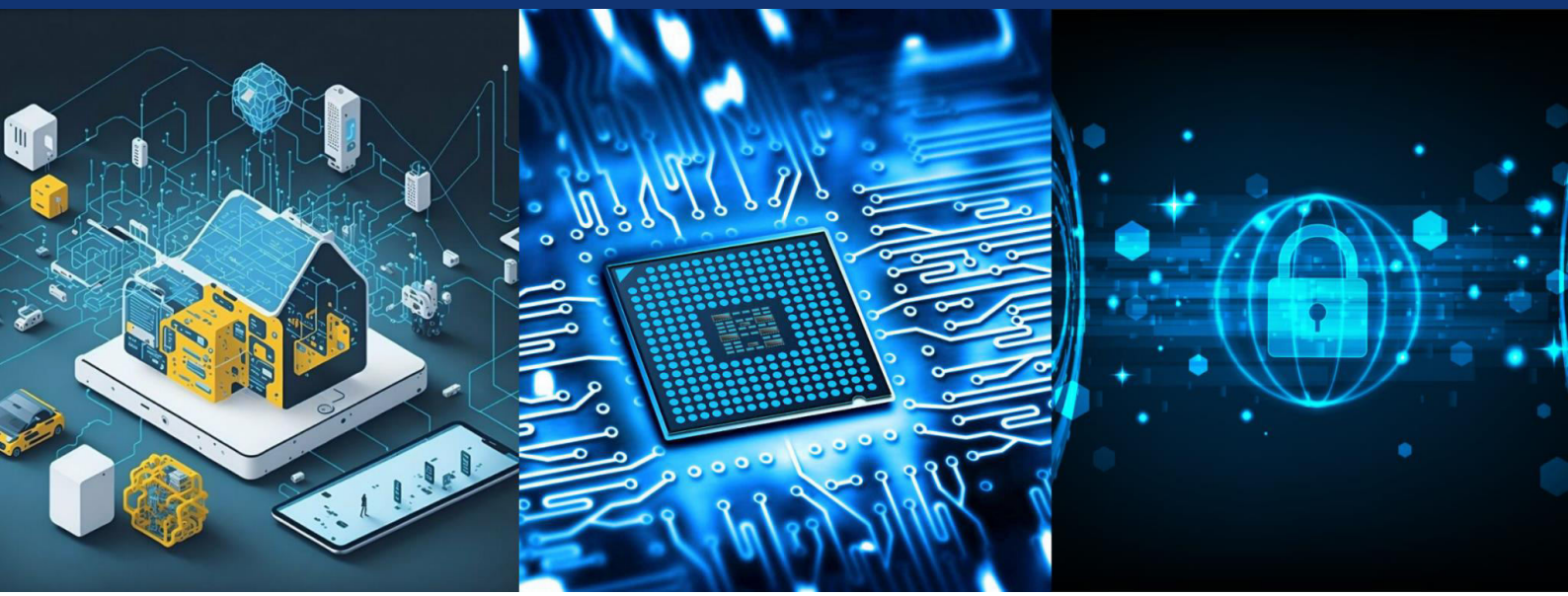
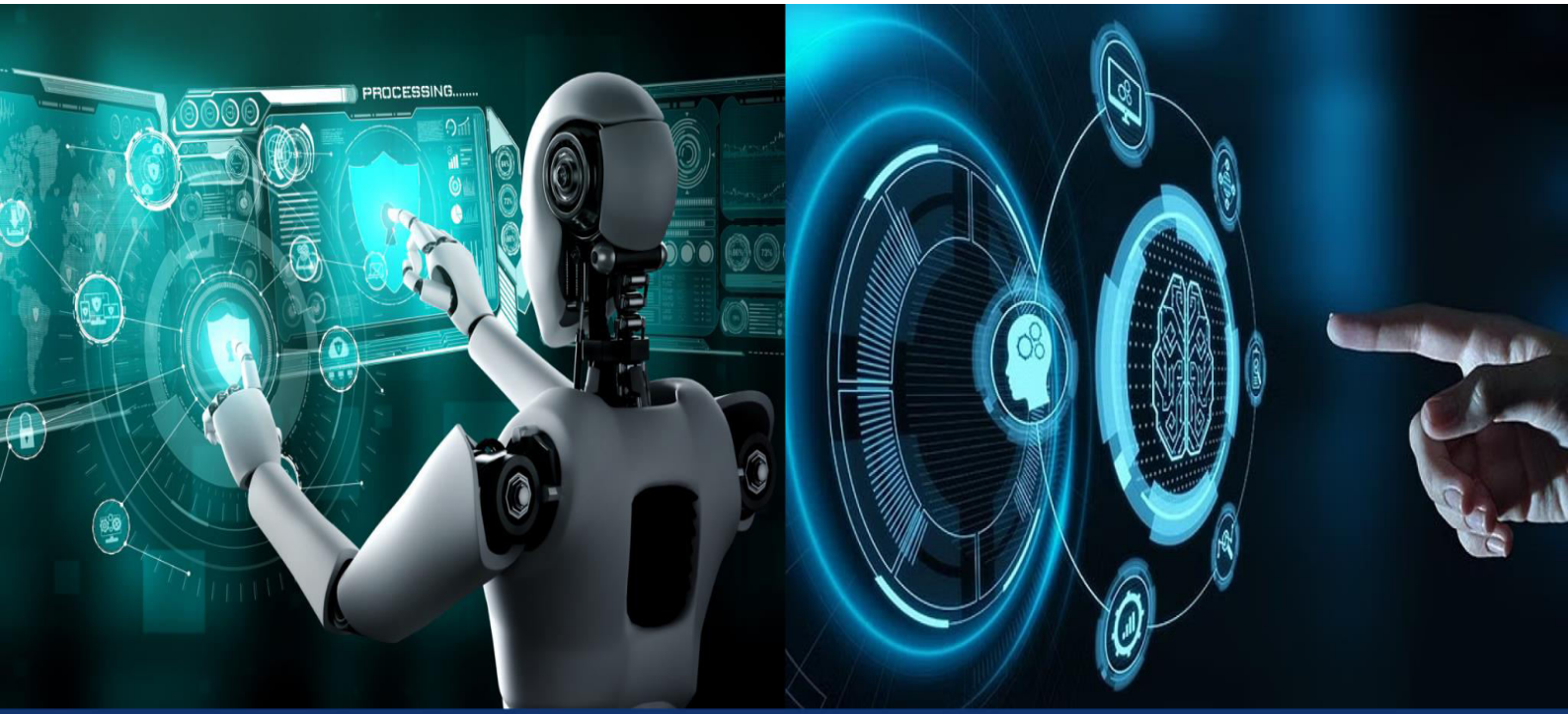


International Journal of Innovative Research in Computer and Communication Engineering

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



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Survey towards Drug Pill Recognition with Deep Learning

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ABSTRACT: Aging is a natural process typically characterized by loss of capabilities such as vision or memory. These transformations interfere with quotidian tasks performance sometimes leading to dangerous situations for senior adults. One of the most relevant is related with the wrong ingestion of medication or even forgetfulness. This kind of mistakes represents a real threat to elder's health and life. Furthermore, the existing technological solutions concerned with this problematic, are designed for professionals or public disregarding elderly needs. Thus, to overcome this lack of support, it will be presented an image processing tool, which represents the first steps for a larger toolset adapted for elderly persons, under construction. The procedures followed by this proposal include image acquisition and pill characterization based on its shape, dimensions, and colours. The system uses these features in the learning step to describe and store pills information on local database. Later, in the recognition step, the same features are determined and compared against database to provide the user with relevant information's related with the pill under recognition.

KEYWORDS: health care, visually impaired, drug pill recognition, image processing, CNN.

I. INTRODUCTION

The advancing of age also brings loss of capabilities such as vision and memory, which exposes elderly persons to dangerous situations. A common one is related with medication. Elderly persons tend to forget or fail the correct ingestion of medication which can lead to serious health damages. On the other hand, when they realize this situation, their self-confidence gets weakened creating the need of a support to change this scenario. Given the situation of Europe - that will continue increasing the imbalance between taxpayers and beneficiaries every year. It is highly unavailable that this support arises from health care system. Thus, in this system, it is proposed an alternative solution based on technological trends, namely mobile devices. This solution is a subset belonging to wider tool support for elderly, under development. It applies computer vision techniques to aid elderly persons on pill identification task, aiming a reinforcement of confidence and autonomy.

In general, visually impaired elderly people will be more likely to take the wrong medicines or forget to take their medication. The study also reported that the subject. Accordingly, errors in drug use affecting visually impaired patients are expected to cause high medical losses, and such patients may not have access to sufficient support in this regard. To overcome this problem, we consider the need for a means of drug pill recognition for visually impaired chronic patients. The proposed methodology can support the medication-use safety of visually impaired chronic patients.

The paper states the review for drug pill recognition for visually impaired person. The section I is introduction of subject and gives overview. The section II considers literature survey done over few papers and datasets formed for recognition while section III gives proposed methodology for the systema.

II. RELATED WORK

There are different approaches had been presented by different researchers. Some of the methods have been presented in this section. To provide related functionalities (such as drug pill recognition and medication reminders) to facilitate safe medication use, many related tools have been developed and assessed.

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A. D. Ushizima, A. Carneiro, M. Souza, and F. Medeiros. “Investigating pill recognition methods for a new national library of medicine image dataset"
Correctly identifying pills has become a critical task in patient care and safety. Using the recently released National Library of Medicine (NLM) pill image database, this paper investigates descriptors for pill detection and characterization. Authors describe efforts in investigating algorithms to segment NLM pills images automatically, and extract several features to assembly pill groups with priors based on FDA recommendations for pill physical attributes. Our contributions toward pill recognition automation are three-fold: we evaluate the 1,000 most common medications in the United States, provide masks and feature matrices for the NLM reference pill images to guarantee reproducibility of results, and discuss strategies to organize data for efficient content-based image retrieval.

B. Z. Yaniv, J. Faruque, S. Howe, K. Dunn, D. Sharlip, A. Bond, P.Perillan. “The national library of medicine pill image recognition challenge: an initial report "
In January 2016 the U.S. National Library of Medicine announced a challenge competition calling for the development and discovery of high-quality algorithms and software that rank how well consumer images of prescription pills match reference images of pills in its authoritative RxIMAGE collection. This challenge was motivated by the need to easily identify unknown prescription pills both by healthcare personnel and the general public. Potential benefits of this capability include confirmation of the pill in settings where the documentation and medication have been separated, such as in a disaster or emergency; and confirmation of a pill when the prescribed medication changes from brand to generic, or for any other reason the shape and color of the pill change. This is an initial promising step towards development of an NLM software system and application-programming interface facilitating pill identification.

Dataset	Parameters checked	Method	Results
Total pill images not specified but the model was tested for 568 pills	Colour, shape, imprint	Modified shape distribution creates an invariant descriptor every time the external factors like lighting vary. The model is based on distance from [17]	Accuracy of 91.13% in Top- 5 identification.
2,152 images from Pillbox database	Shape, colour, imprint	Histogram of Oriented Gradient and Support Vector Machine is used for single drug localisation. A multi-CNN model comprising of Gray, colour and gradient CNN is applied to collect pill characteristics [13]	Accuracy of 73.7% in Top-1 identification for both side of pill images
Pillbox database (2,000 training, 1,000 validation, 4,000 testing)	Shape, colour	Three GoogLeNet models combined with decision fusion and data augmentation have been used. They are trained on ImageNet Large Scale Visual Recognition Challenge data for colour, shape and feature. K-means clustering is used for the formation of shape classes. [18]	MAP score of 0.328 achieved
Self-prepared dataset of 400 tablets. In total 5284 images were captured. (4884 training, 400 testing)	Shape, colour, texture, imprint	Deep Convolutional Network is used for identification. A structure similar to AlexNet is developed with deep learning framework being Caffe. Preprocessing of data done using ImageNet. k-NN is also tried but due to the poor quality of results, not taken forward. [9]	Accuracy of 95.35% in Top-1 identification
2152 images from Pillbox database (400 training, 100 validation and 1652 testing)	Shape	The shape is predicted by forming two adaptable rings, the area bounded by them and the number of overlays of the two rings. For classification, both the neural network and decision tree have been tested. A conjugate gradient backpropagation algorithm is used for the network. [14]	98.7% accuracy is achieved with an error rate of 1.3%. The model is indifferent to size and rotation.
1000 images from PILLbox dataset and 200 images from reference image set	Shape, colour	Invariant feature extractor proposed based on colour and shape. Tried and tested on k-NN, Support Vector Machines and Bayes.[19]	Accuracy of approximately 99.85%
Self made (488,520 training, 8,280 validation, 1,680 testing)	Any particular not specified	ResNet 50 and Feature Pyramids Networks are used for drug localization. Classification and regression models have been used to improve bounding box formation. Xception model is used for prediction. [16]	Accuracy of 79.4% in Top-1 identification
1926 images from Pillbox database (80% training, 20% validation)	Shape, colour	Image processing used for shape and colour feature extraction. *k*-means clustering is used for colour identification. Then Support Vector Machines and Multilayer Perceptron neural network are used to classify the pills. One-vs-One method is used to turn Support Vector Machine into a multi-class classifier. [20]	Accuracy of about 99.3%
7000 images from Pillbox database	Shape, colour	Blob-detection neural network and morphological post-processing are used for drug localization. ResNet-50 is used for classification. Based on a fully connected neural network. This process now does not take place on the mobile itself.[21]	MobileNet and Inception v3 can be potential substitutes for the classifier. In Top-5 identification accuracy of 94% achieved
Drug Pills Image Database (2,393,585 training, 34,975 validation, 1193 testing)	Any particular not specified	For localization, Feature Pyramid Network and Global Convolution Network is used and for classification, Inception-ResNet v2 is used. [5]	96% accuracy is achieved in localization and 82.1% in Top-1 identification.
7000 images from Pillbox database and self-prepared dataset CURE of 8973 images (64% training, 16% validation and 20% testing)	Shape, colour, imprint, texture	Pill segmentation and localization are performed using W^2-net. Multi-stream fusion network created from CNN stream feed of RGB, texture, imprint and counter. [8]	Accuracy of 64.2% and 53.7% achieved for NLM and CURE datasets respectively.

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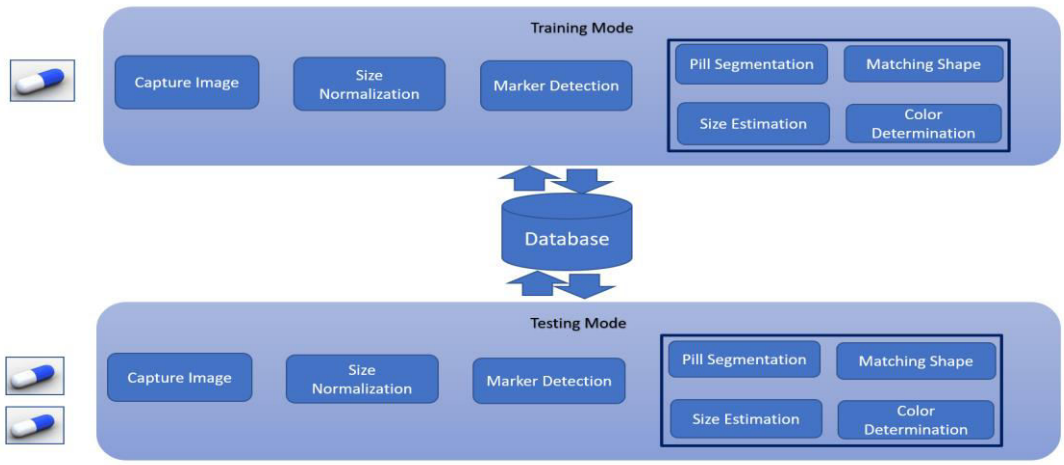
C. R. A. Calix, R. Gupta, M. Gupta, and K. Jiang. "Deep gramulator: Improving precision in the classification of personal health experience tweets with deep learning "
Health surveillance is an important task to track the happenings related to human health, and one of its areas is pharmacovigilance. Pharmacovigilance tracks and monitors safe use of pharmaceutical products. Twitter data can be used for this task given that users post their personal health related experiences on-line. One problem with Twitter data, however, is that it contains a lot of noise. Therefore,
an approach is needed to remove the noise. In this paper, several machine learning algorithms including deep neural nets are used to build classifiers that can help to detect these Personal Experience Tweets (PETs). Finally, we propose a method called the Deep Gramulator that improves results. Results of the analysis are presented and discussed.

D. W.J. Chang, L.-B. Chen, C.-H. Hsu, C.-P. Lin, and T.-C. Yang. "A deep learning-based intelligent medicine recognition system for chronic patients "
This paper proposes an intelligent medicine recognition system based on deep learning techniques, named ST-Med-Box. The proposed system can assist chronic patients in taking multiple medications correctly and avoiding in taking the wrong medications, which may cause drug interactions, and can provide other medication related functionalities such as reminders to take medications on time, medication information, and chronic patient information management. The proposed methodology consists of an intelligent medicine recognition device, an app running on an Android based mobile device, a deep learning training server, and a cloud-based management platform. Currently, 80 different medicines can be recognized by the proposed methodology.

E.M. Ervasti, M. Isomursu, and I. I. Leibar. "Touch- and audio-based medication management service concept for vision impaired older people "
The service concept allows older users with vision impairments to manage their daily medications autonomously by providing them means to identify medicines and retrieve personal medication information. In order to demonstrate the feasibility of the concept, an early prototype called Blind NFC was implemented. It is a NFC enabled PDA with a basic functionality of reading the medicine name and dosage information aloud by touching the medicine package. Findings revealed that older users learned and used the basic functionality of touch- and audio-based system quite easily. They found potential value in the technology also in tagging and identifying other everyday physical objects than medicine packages and using their own self recorded audio messages for marking objects.

III. PROPOSED METHODOLOGY

A. System Architecture:
The proposed methodology includes image acquisition and pill characterization based on its shape, dimensions and colours. The system uses these features in the learning step to describe and store pills information on local database. Later, in the recognition step, the same features are determined and compared against database in order to provide the user with relevant information related with the pill under recognition.



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IV. CONCLUSION AND FUTURE WORK

The proposed algorithm for drug pill recognition is deep learning, for visually impaired chronic patients. The proposed methodology consists of a pair of wearable smart glasses, an artificial intelligence (AI)-based intelligent drug pill recognition box, a mobile device app, and a cloud-based information management platform and is designed to support safe medication use. The proposed methodology uploads medication information to the cloud-based management platform to build medication-use records, allowing family members or caregivers to monitor the medication status of visually impaired chronic patients by using the mobile device app. Hence, the proposed methodology can effectively mitigate the problem of drug interactions caused by taking incorrect medications, thereby reducing the cost of medical treatment and providing visually impaired chronic patients with a safe medication environment.

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