AYURVEDIC LEAF DETECTION USING RASPBERRY PI

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I. ABSTRACT

There are numerous ways for classifying herbal plants based on leaf authenticity now available. Leaf authentication is essentially a visual comparison of photos captured by a camera with a visual image reference. The goal of this paper is to use artificial intelligence, namely the convolutional neural network (CNN), to recognize ayurvedic leaves using the Raspberry Pi. CNN has the advantage of not requiring feature extraction because it has an automated feature extraction technique built in. The leaves of four distinct ayurvedic plants are separated into two thirds training data and on testing data in this paper. The remaining data not involved in training and testing of the system will be used to validate the outcomes of the CNN-based identification system.

Keywords—Raspberry pi; CNN; leaf detection; ayurvedic

II. INTRODUCTION

The phrase IoT, which stands for Internet of Things, has been a popular buzzword in the IT sector for the past several years. The Internet of Things (IoT) is a term used to describe all objects that are, well, connected to the Internet. The Internet of Things (IoT) is defined as the network of actual objects—devices, cars, buildings, and other things—that are outfitted with electronics, software, sensors, and network connectivity to collect and share data. Although this is a reasonable summary of the functions performed by IoT systems, we believe that IoT encompasses more than just a collection of data-gathering sensors. In order to extract usable information from the data acquired (typically Big Data), IoT specifically entails processing. The Raspberry Pi is an open-source hardware platform that has become quite popular with hobbyists recently. More specifically, IoT entails the processing of the data (sometimes Big Data) received to derive relevant insights and enable better decision-making.

Ayurvedic doctors used to select the medicinal plants and create the medications for their patients themselves in the past. Only a few practitioners still use this method now. Ayurvedic medication production and marketing has grown into a booming sector with annual sales of over Rs 4000 crores. There are easily more than 8500 manufacturers of Ayurvedic drugs in India. Several concerns about the quality of the raw ingredients used to make Ayurvedic medications have come to light as a result of the commercialization of the Ayurvedic industry.

The case study's current objective is to detect the medicinal leaves using convolutional neural network (CNN), an artificial intelligence technique that is implemented on the Raspberry Pi. One benefit of this approach is the automatic feature extraction process, which eliminates the requirement for feature extraction altogether. Because CNN expects input in the form of an image matrix, it is more effective at identifying and classifying objects. Plant leaf photos will be analysed on a Raspberry Pi running a Convolutional Neural Network (CNN). Other data not used in training or testing, as well as leaf data other than the type of leaf is identified, will be used to validate the outcomes of the identification procedure.

a) Overview

The current goal is to detect the ayurvedic leaves using the convolutional neural network (CNN) method, which is further applied on the Raspberry Pi. One benefit of this approach is the automatic feature extraction procedure, which eliminates the requirement for feature extraction altogether. Because CNN expects input in the form of an image matrix, it is more effective at identifying and classifying objects. Plant leaf photos will be analysed on a Raspberry Pi running a Convolutional Neural Network (CNN). Other data not used in training or testing, as well as leaf data other than the type of leaf that is identified, will be used to validate the outcomes of the identification procedure.

b) Challenges

The challenges currently being faced in this area is the compatibility of the operating system and the languages used to develop the project. There is no proper support available as of now for many issues. However, the presented solution has nearly overcome this issue and is built with the compatible development tools.

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III. Raspberry Pi:

It is computer, that is od the size of a credit card, the Raspberry Pi can communicate with a wide range of sensors as well as other modules like LCD screens, servos, and motors. The Raspberry Pi is a single-board computer that costs little money and uses less energy. This may connect to a computer or TV monitor and begin utilising it after some initial setup. If the Raspberry Pi is not configured in headless mode, additional hardware such as a mouse and keyboard are also required. To utilise the Raspberry Pi in headless mode, all you need is a computer and a USB cord. The Raspberry Pi features 40 GPIO pins that can be used to connect external sensors or devices.

a. Uses of Raspberry Pi

There are so many things that can be made with a Raspberry Pi and due to its extreme popularity, the number of third-party sensors, modules, and code libraries has grown to epic proportions. This has greatly expanded the possible applications for the Raspberry Pi in the IoT field too. The applications really are endless. here are some common ones:

1. Home automation
2. Medical or heart monitoring devices.
3. Local network hubs for IoT
4. Sensor control
5. Robotics control.

IV. RELATED WORKS

In order to extract a structural signature that quantifies the leaf shape feature, Parag Bhandarkar, Rizwan Ahmed, and et.al first deconstructed the morphology of leaf edges using established structural elements. For calculating the identity, they employed the root mean square error between the feature vectors of the input image and the image in the database. The authors' database is made up of 40 samples of leaves from 10 different species. They acquired a 67.5% categorization rate overall, which is unaffected by the size or orientation of the leaves. For use in real applications, the identification rate is relatively low

Aspect ratio, form factor, rectangularity, perimeter ratio of diameter, solidity, convexity, and irregularity features were adopted by B. S. Harish, Aditi Hedge, et al. as geometrical properties, while Zernike moments were used as a shape descriptor. An accuracy of 89% was obtained from the studies using the Flavia database and a database that the authors had built. They tabulated the data after contrasting the performance of four distinct classifiers based on geometrical and Zernike moment feature sets independently. It was found that Zernike moments performed better in all classifiers than geometrical descriptors in terms of accuracy. The experiment used the Naive Bayes classifier, K-NN, support vector machine, and PNN classifiers. It is evident from earlier research that geometrical, chromatic, and textural characteristics of leaves are employed to identify the plant

Scale Invariant Feature Transform (SIFT) was applied by Nuril Aslina, Nursuriati Jamil, and others as a shape descriptor and colour moment. The image is divided into two HSV planes, with nine grids on each plane. For each grid in every plane, colour moments are calculated and used as feature vectors. Identification is done using the smallest Euclidean distance between the test and training sets. The authors built their database by collecting 40 photographs of Malaysian herb leaves taken in their natural habitat under daylight. Independent of image rotation and scaling, an accuracy of 87.5% is obtained. SIFT requires a lot of processing power to extract essential point features.

V. SYSTEM DESIGN

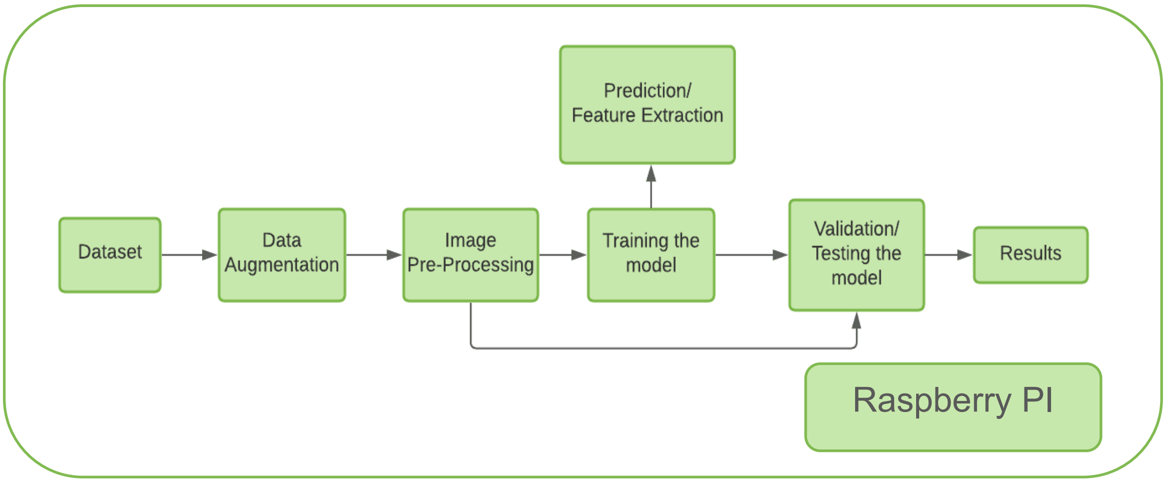

Fig 1. Methodology of the Project

The designing of the model is done in a way, so that the whole project is built, processed and deployed on the same raspberry pi. The steps followed in the project is as shown in the above flow chart.

a) Dataset

The presented system is mainly trained using the ayurvedic leaves of four different plants which are as shown in the below figure. It contains pictures of 4 species of leaves, with 75 images per species. Images are clean with a white background, with very few variations of colour or luminance.

(a)Ulmus Carpinifolia (b) Eucalyptus Globulus (c) Populus Tremula (d) Ulmus Glabra

Fig 2. Dataset of the Ayurvedic leaves

b) Data Augmentation

Augmentation is used to change the orientation and layout of a particular image, thereby creating multiple different versions of the same image. This allows the model to be more flexible in terms of all angles and orientations, also helping us increase the training size. The currently used library is called 'Augmentor' for this purpose; this library allows to customize dataset as required.

c) Image Pre-processing

CNN uses deep learning to categorise images of leaf samples in machine image processing. Deep learning, a self-learning method that uses a large amount of data, has become increasingly feasible due to recent advancements in hardware and information processing technologies.

CNN extracts and detects characteristics simultaneously, unlike other classifiers, resulting in a speedier recognition process. However, before this classifier is judged competent enough for use, users must train it on many sets of data.

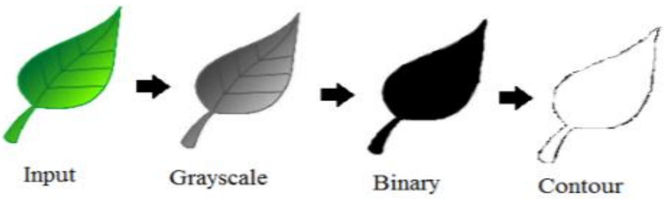

Fig 3. Image processing Stages

The image resizing and grayscale scaling were used for this simple model. To improve image contrast and intensity, grayscale conversion of the image into geometrical data is used. The thresholding procedure then builds a binary image, assigning a value from 0 to 255 to each pixel based on its brightness, as seen in Figure 3. Later, performed normalisation on these batches to reduce the matrices values to less than ones

d) Training the Model

The model is trained on a CNN architecture that is appropriate for the current situation on our pre-processed dataset so that the system can automatically recognise the leaf's target class. We implemented this using the Tensorflow with Keras framework.

The classifier is a custom-built model, following the below guidelines:

a. Convolutional layer learning can range from generic to particular, and adding more layers can aid with the latter.
b. Overfitting is reduced by dropping out.
c. To reduce dimensionality, use aggressive pooling.

e) Prediction and testing the model

The prediction was done on raspberry pi using the model developed. A higher preference was given to the matching and prediction of the leaf image, rather than accuracy. The model provided agreeable accuracy for the predictions.

f) Results

The currently developed model on The Raspberry pi is an IOT application which tends to work based on the model customized to work specifically on Raspberry pi. The model accepts the input of the provided image file, then processes the image file to a grey-scaled image which is later on used by the CNN model in order to compare and predict the Biological or the scientific nomenclature of the input leaf.

VI. REFERENCES

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