AYURVEDIC LEAF DETECTION USING RASPBERRY PI

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 reference visual image. 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 one-third 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

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I. INTRODUCTION

One of the buzzwords used heavily in the IT industry for the past couple of years is the term IoT, which stands for Internet of Things. IoT refers to all of the things that are, well, connected to the Internet, and that's how it got its name. IoT is defined to be: the network of physical objects - devices, vehicles, buildings and other items - embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. Although this is a fairly accurate description of the roles played by IoT systems, it's our opinion that IoT is more than the collection of data-using sensors. More specifically, IoT involves the processing of the data (often Big Data) collected to derive useful information and support better decision-making open-source hardware platform that has gotten very popular with hobbyists these days is Raspberry Pi.

In the ancient past, the Ayurvedic physicians themselves picked the medicinal plants and prepared the medicines for their patients. Today only a few practitioners follow this practice. The manufacturing and marketing of Ayurvedic drugs has become a thriving industry whose turnover exceeds Rs 4000 crores. The number of licensed Ayurvedic medicine manufacturers in India easily exceeds 8500. This commercialization of Ayurvedic sector has brought in to focus several questions regarding the quality of raw materials used for Ayurvedic medicines.

The current goal of the case study is to identify the herbal leaves using an artificial intelligence method, the convolutional neural network (CNN), which is applied to the Raspberry Pi. One of the advantages of this method is that there is no need for feature extraction because there is an automatic feature extraction process. CNN is more efficient in the identification and classification process because CNN assumes input in the form of an image matrix. Leaf images of a plant will be processed in Raspberry Pi in which Convolutional Neural Network (CNN) has been installed. The results of the identification process will be validated with other data excluded in training and testing as well as leaf data other than the type of leaf that is identified.

1. **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 of the advantages of this method is that there is no need for feature extraction because there is an automatic feature extraction process. CNN is more efficient in the identification and classification process because CNN assumes input in the form of image matrix. Leaf images of a plant will be processed in Raspberry Pi in which Convolutional Neural Network (CNN) has been installed. The results of the identification process will be validated with other data excluded in training and testing as well as leaf data other than the type of leaf that is identified

2. **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.

II. RASPBERRY PI

The Raspberry Pi is a credit card sized computer that can connect to a huge variety of sensors and other modules like LCD displays, servos, and motors. The Raspberry Pi is a low-cost, low power consumption, credit-card-sized single-board computer. After some initial setup, this can connect to a computer or TV monitor and start using it. Aside from a monitor, the Raspberry Pi will also need a mouse and keyboard, if it is not set up in headless mode. In headless mode you only need a computer and a USB cable to use the Raspberry Pi. The Raspberry Pi has 40 GPIO pins to connect external peripherals or sensors.

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:

- Home automation
- Medical or heart monitoring devices.
- Local network hubs for IoT
- Sensor control
- Robotics control.

III. RELATED WORKS

Parag Bhandarkar, Rizwan Ahmed et al. decomposed the morphology of leaf edges using predefined structural elements and extracted a structural signature which quantifies the leaf shape feature. They used the root mean square error between the feature vectors of the input image and the image in the database for computing the identity. The database created by the authors consists of 40 leaf samples of 10 different species. They achieved an overall classification rate of 67.5%, which is independent of leaf size and orientation. The identification rate is comparatively low to be of use in practical implementations.

B. S. Harish, Aditi Hedge et al. used aspect ratio, form factor, rectangularity, perimeter ratio of diameter, solidity, convexity, and irregularity as geometrical features, Zernike moments as shape descriptor. The experiments were conducted on Flavia database and a database created by the authors yielding an accuracy of 89%. They compared the performance of four different classifiers based on geometrical and Zernike moment feature sets separately and tabulated the results. It is observed that Zernike moments gave better accuracy in all the classifiers when compared to geometrical descriptors. Naive Bayes classifier, K-NN, support vector machine and PNN classifiers were used in the experiment. From the previous work, it is clear that geometrical, colour, texture features of leaf are used to identify the plant.

Nuril Aslina, Nursuriati Jamil et al. used Scale Invariant Feature Transform (SIFT) as a shape descriptor and colour moments. The image is decomposed in to HSV planes and each plane is divided into 9 grids. Colour moments are calculated for each grid of every plane and used as feature vector. Least Euclidean distance between test and training sets are used for identification. Database is created by the authors by acquiring 40 leaf images of Malaysian

herbs from natural habitat in natural light. An accuracy of 87.5% is obtained independent of scaling and rotation of images. SIFT is computationally intensive when used to extract key point features.

IV. SYSTEM DESIGN

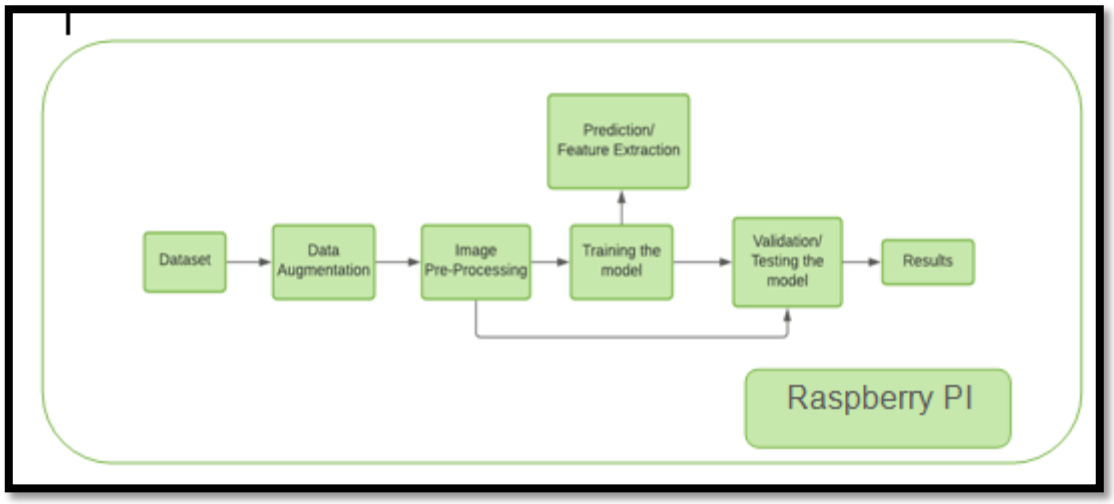

Figure 1: Methodology of the Project

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.

1. **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.

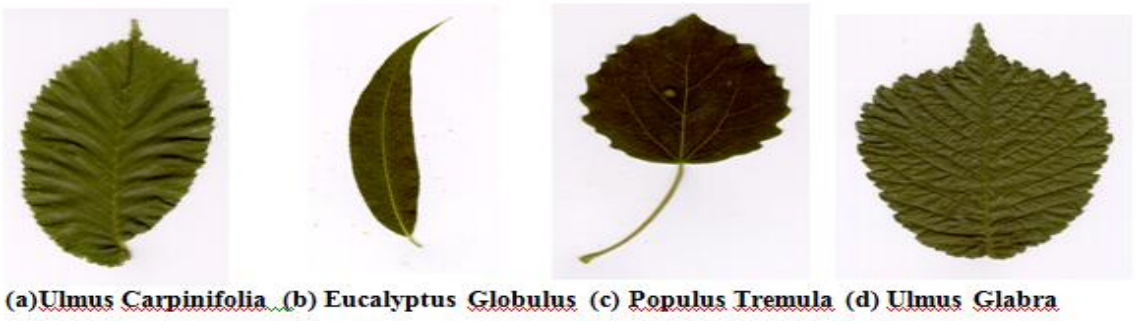

Figure 2: Dataset of the Ayurvedic leaves

2. **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.

3. **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

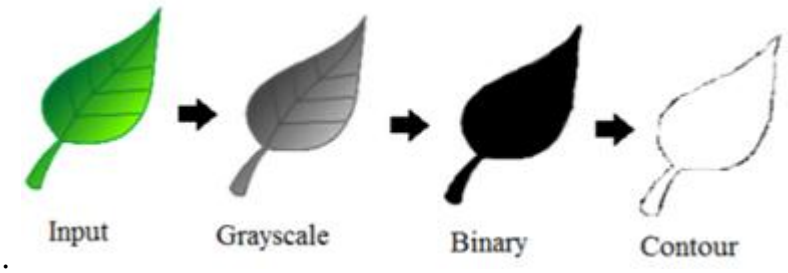

Figure 3: Image processing Stages

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 one.

4. **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:

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

5. **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.

6. **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 takes the input of the given image file, then processes the image to a gray-scaled image which is then used by the CNN model to match and predict the name of the input leaf.

REFERENCES

[1] Nithu V.C. & Liju Philip & Deepa J., An embedded system for identification and confirmation of ayurvedic plant using known leaf image database, International Journal of Engineering and Technology, 2018.
[2] Haryono, Khairul Anam, Bambang Sujanarko, Herbal Leaf Authentication using convolutional neural network using raspberry pi 3.,
[Manojkumar P., Surya C. M., Varun P. Gopi, Identification of Ayurvedic Medicinal Plants by Image Processing of Leaf Samples,
[3] B.S.Harish, Aditi Hegde, OmPriya Venkatesh, D.G.Spoorthy, D.Sushma, Classification of plant leaves using morphological features and zernike moments,
[4] Parag Bhandarkar, Parag Doshi, Harshal Kadakia, Mamata Ahmed, Rizwan Leaf identification using morphology and structural decomposition.. Bhandarkar, Parag Doshi, Harshal Kadakia, Mamata Ahmed, Rizwan. 2014
[5] A. Gopal, S. Prudhveeswar Reddy, and V. Gayatri, -" Classification of selected medicinal plants leaf using image processing," 2012 Nursuriati Jamil*, Nuril Aslina Che Hussin, Sharifalillah Nordin, Khalil Awang – "Automatic Plant Identification: Is Shape the Key Feature", International 43
[6] R. G. De. Luna, Identification of Philippine herbal medicinal plant leaf using artificial neural network, HNICEM 2017.9th conference. HUmanoid, nanotechnology.inf technology, communication, control, environment, management.col 2018-January. no December.pp. 1-8 2018

