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Developing an Identification System for Different Types of Edible Mushrooms in Sri Lanka using Machine Learning and Image Processing

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ABSTRACT

This study aims to develop an image processing-based approach to identify edible mushroom species from other mushrooms using CNN and identify edible mushrooms based on ANN and identification growth stage of edible mushrooms using CNN image processing techniques. The identification of mushrooms can be challenging, especially for non-experts, due to the morphological similarities between edible and poisonous species. Also there have similarities between edible mushroom species. Therefore, there is a need for an accurate and efficient method to differentiate between edible and non-edible mushrooms and edible mushroom species. In this study, we propose the use of image processing techniques, such as feature extraction, segmentation, and classification, to analyze images of mushrooms and distinguish between edible mushroom species. We will collect images of different mushroom species found in Sri Lanka and use them to train and test our image processing algorithm. we will collect images of edible mushrooms are divide in to growth stage. Our approach has the potential to improve the safety and accessibility of wild mushroom harvesting, promote the consumption of nutritious edible mushrooms, and prevent accidental ingestion of poisonous mushrooms and improve identify edible mushroom species and find the growth stage of edible mushrooms. (*Abstract*)

Keywords— Component, Formatting, Style, Styling, Insert, CNN, ANN

I. INTRODUCTION

Mushrooms are a significant source of food and medicine in many parts of the world, including Sri Lanka. However, identifying edible mushroom species in Sri Lanka can be challenging, especially for villagers. However, some edible mushrooms resemble poisonous species, making it difficult to differentiate between them. In Sri Lanka, wild mushrooms are collected and consumed for their nutritional and medicinal value, but there have been reports of accidental poisoning due to misidentification [1]. The cultivation of edible mushrooms is a trend in the Sri Lankan market. Unfortunately, certain types of mushrooms are deadly and contain toxins that can make people sick or even lead to death. Around 70% of all-natural poisoning is caused by mushrooms, and it frequently results in death. But nonetheless, out of the hundreds of species found on Earth, only 30 to 50 are toxic, and only 10 of them are lethal. Traditionally, the identification of mushrooms has relied on morphological characteristics such as cap shape, gill attachment, and spore color. However, this method needs to also identify experts. With the advent of digital imaging and computer vision technologies, there has been a growing interest in using image processing techniques to automate mushroom identification [2]. In recent years, extensive data analysis and machine learning technologies have become increasingly important in agriculture. Image processing involves analyzing and manipulating digital images to extract useful information. It has been successfully applied in various fields, including medical imaging, surveillance, and agriculture. In recent years, image processing has also been used to identify and classify mushrooms based on their visual features. Therefore, the proposed project aims to develop an image processing-based approach to identify edible mushrooms from other mushrooms found in Sri Lanka. The approach will use advanced image processing techniques, such as feature extraction, segmentation, and classification, to analyze images of mushrooms and distinguish between edible and non-edible mushrooms and edible mushroom species. This method has the potential to provide a more accurate and efficient way of identifying mushrooms, which will improve the safety and accessibility of wild mushroom harvesting, promote the consumption of nutritious edible mushrooms, and prevent accidental ingestion of poisonous mushrooms [3]. Using the Template. The In summary, the skill of identifying edible mushroom species from others offers a

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range of valuable benefits. From expanding culinary possibilities and nutritional intake to fostering sustainable foraging practices and a deeper connection to nature, the ability to discern between safe and toxic varieties is both rewarding and essential. This skill promotes self-sufficiency, mindfulness, and cultural preservation, while also preventing potential health risks associated with consuming poisonous mushrooms. Whether for culinary exploration, economic gain, or personal achievement, mastering mushroom identification is a pathway to a safer, more enriching engagement with the natural world. Mushrooms, as the visible reproductive structures of fungi, undergo a series of developmental phases that culminate in the emergence of distinct forms, textures, and colors. Understanding these growth stages is essential for successful cultivation, foraging, and appreciation of these enigmatic organisms.

Mushroom growth can be categorized into several key stages, each marked by specific morphological changes and physiological processes. From the delicate emergence of mycelium, the vegetative thread-like structure, to the eventual appearance of the fruiting body that captures our attention, each stage contributes to the awe-inspiring diversity of the fungal world. Exploring these growth stages not only unveils the complex lifecycle of mushrooms but also underscores their ecological significance, cultural importance, and potential applications in various fields.

II. LITRITURE REVIEW

In in Sri Lanka, the wet and intermediate zones are where discovering the greatest number of wild edible mushrooms. Recent estimates indicate that despite my Cota in Sri Lanka has a tremendous diversity, it has received very few research and is still not well known. Up to 25,000 species of fungus may exist in Sri Lanka. The number of exotics introduced alongside food, plantation, and decorative plants is far more than the 2000 that are now recognized, and this estimate does not account for them. Since the introduction of commercially viable mushroom cultivation in Sri Lanka in 1985, both endemic and exotic species are being grown there [17]. Much research has used a range of classification techniques to categorize mushrooms. The mass, or mushroom diagnosis assistance system, was created by [18] and consists of the following elements: a preprocessed database, a client for smartphones like an app, and a server to operate the program online.

1.2.2 Existing systems

The influence of cutting-edge technology on human lives was significant. Many instruments have been created to improve life. The academic area known as machine learning (ml) enables computers to learn from data [5]. ML is used to make judgments and extract information from data. All different kinds of industry have employed it. Many machine-learning techniques are used to extract the best answer from vast collections of data. A two-step method is included in data classification. The initial phase in the process is learning, which is represented by building a categorization model. The second procedure is a classification (testing) step, and in this step, the generated model is shown. This model utilized the provided data to forecast the classes for them. The methods employed depend on the types of datasets, quantity of variables, and models employed. An ML method known as supervised learning converts inputs into outputs using sample input-output pairs. Two sets of data—training and data sets—will be created. The test dataset is classified using the patterns that were established on the training set. The unsupervised technique uses previously classified or learned characteristics to categorize fresh data. Unsupervised learning methods like k-means are used to overcome the clustering issue. For each cluster, k centers are specified. It is preferable to position them apart from one another. One popular way for displaying options and their outcomes as a tree is the decision tree. id3, j48, c4.5, random forest, random tree, id3+, oci, and clouds are a few of the implementations that it has. Based on their behavioral characteristics, mushrooms have been classified as either edible or poisonous [4]. They utilized the j48 implementation, and both the training and test sets ran at the exact same speed with 100% correctness. a comparison of the most popular classification techniques [6] reveals that KNN produced the best results. KNN and naive bayes are combined to get results that are more precise and effective [7]. The classification method known as naive bayes is founded on basic theory. To determine probabilities, naive base counts the frequencies of the data and their values. It is predicated on the idea that each characteristic in a class is distinct from the others [8]. Research have state that the performance of Bayesian classifier is superior compared to the performance of decision tree and chosen neural network [9]. Naive bayes exhibits more accuracy than KNN when employed in image processing techniques to categorize mushrooms [10]. Artificial neural networks (ANN) are parallel computational models with highly linked adaptive processing units that can learn from experience as well as acquire new information. One use of ANN is the classification of mushrooms as either edible or poisonous [11]. The ability of a neural network to predict whether a mushroom is edible [12]. The prediction rate was 99.25% on average. Nonetheless, they constructed a feed-forward multi-layer perceptron network using the Justin environment, which included a single input layer, three hidden layers, and a single output layer. An accurate comparison research demonstrates that svm outperforms all other algorithms by 76% [13]. The research used the feel of the mushroom to assess whether it was edible or not. Training and decision-making processes are applied in a two-phase approach [9]. Both naive bays and decision tree classifiers are employed, with decision tree providing superior accuracy but naive bays taking somewhat less time [4]. 3 a machine learning (ml) model for classifying mushrooms using 800 samples and 22 physical dada characteristics [14]. The study tested KNN with sgd text, naive bayes, naive bayes, and other algorithms. KNN had the greatest accuracy. Nonetheless, 200 samples of edible and inedible materials were used in the study. Anfis performed with the best accuracy, according to a different study [15]. Several more research have been carried out, with an emphasis on the performance and accuracy of the particular models. To attain better results, a hybrid model that combines all strategies might be used [16]

In the field of Health such as: Parkinson's Disease Prediction, Classification Prediction of SBRCTs Cancers Using ANN [17], Predicting Medical Expenses Using ANN[18], Predicting Antibiotic Susceptibility Using Artificial Neural Network[20], Predicting Liver Patients using Artificial Neural Network[19], Blood Donation Prediction using Artificial Neural Network[21], Predicting DNA Lung Cancer using Artificial Neural Network[22], Diagnosis of Hepatitis Virus Using Artificial Neural Network[23], COVID-19 Detection using Artificial Intelligence[24].

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In the field of Agriculture: Plant Seedlings Classification Using Deep Learning [24], Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network[25], Analyzing Types of Cherry Using Deep Learning[25], Banana Classification Using Deep Learning[23], Mango Classification Using Deep Learning[26], Type of Grapefruit Classification Using Deep Learning[27], Classifying Nuts Types Using Convolutional Neural Network[27], Potato Classification Using Deep Learning[28], Age and Gender Prediction and Validation Through Single User Images Using CNN[5].

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III. METHODOLOGY

A. Data Collection and Preprocessing

A diverse dataset of mushrooms has been collected from local farms and markets to ensure the representation of different mushroom varieties. High-resolution images of mushrooms showing various mushroom species have been obtained from mushroom plantations in collaboration with farmers and external supervisors. Detailed discussions with farmers have been conducted to gather information on current cultivation practices, including planting density, fertilization, irrigation, and pest control measures. The collected data will undergo preprocessing steps to handle missing values, resize images, and normalize variables, ensuring data consistency and usability.

B. Feature Extraction and Selection

For mushroom species recognition, feature extraction and selection techniques will be employed to derive relevant and discriminative attributes from the collected data. These features will include physical attributes (e.g., size, color, shape, texture) for mushroom variety identification. Feature selection will help enhance model performance by reducing dimensionality and focusing on the most informative attributes.

C. Machine Learning Model Development

Convolutional Neural Networks (CNNs) and artificial neural network (ANN) will be utilized as the primary machine learning algorithm for function. For mushroom variety identification and growth rate identification, a CNN model has been trained on the labeled dataset of mushroom images to learn the distinctive features and patterns associated with each variety. Similarly, for mushroom species recognition, a separate CNN model will be trained using the labeled dataset of mushroom species images to accurately classify and identify species and growth stage of mushroom.

D. Model Training and Evaluation

The developed CNN models will be trained using appropriate optimization techniques and loss functions. The training process will involve splitting the dataset into training and validation sets to monitor model performance and prevent overfitting. Performance evaluation metrics, such as accuracy, precision, recall, and F1-score, will be employed to assess the effectiveness of the models in mushroom species identification.

E. Mobile Application Development

An intuitive and user-friendly mobile application will be de- veloped to integrate the trained CNN models. The application will allow users to upload photos of mushroom species for instant variety identification recognition. The user interface will be designed with user experience in mind, providing clear instructions for photo capture and display of results in a visually appealing format.

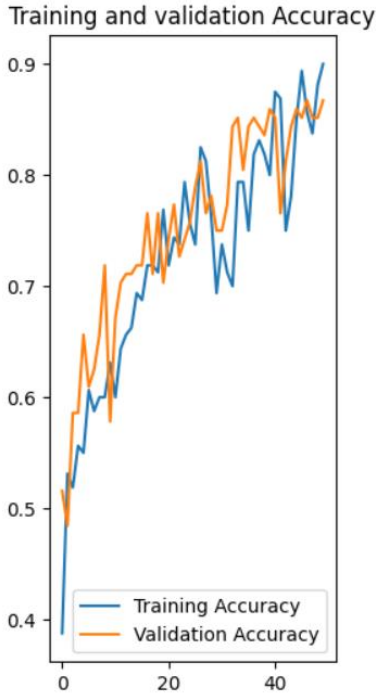
F. Enhanced User Experience

To enhance the user experience, additional features will be incorporated into the mobile application. Users will receive identified mushroom species.

IV. RESULTS AND OUTCOME

1. Identify Edible Mushroom Species

In my project got valuable results. First, capture the mushrooms and find the relevant species of mushroom. First, I trained the dataset. On that I get 90% accuracy for my project. The dataset breaks to train and validation dataset. After that train the dataset. Training and validation rates start as low rates, and it ends around 90% accuracy.



After training the dataset clearly identifies edible mushroom species correctly. Using validation dataset assign the dataset with numbers and validate the dataset and the results get correctly.

2. Identify Growth Stage Edible Mushroom

In project got valuable results. First, capture the mushrooms and find the relevant species of mushroom. First, I trained the dataset. On that I get 90% accuracy for my project. The dataset breaks to train and validation dataset. After that train the dataset. Training and validation rates start as low rates, and it ends around 90% accuracy.

After training dataset clearly identify growth stage of mushroom

3. Identify Edible Mushroom or Not

In project got valuable results. First, got the dataset and train the dataset get the result edible or not

TABLE 1. Mushroom dataset attribute information

No	Attribute	values
1	cap-shape	bell=b,conical=c,convex=x,flat=f, knobbed=k,sunken=s
2	cap-surface	fibrous=f,grooves=g,scaly=y,smooth=s
3	cap-color	brown=n,buff=b,cinnamon=c,gray=g,green=r, pink=p,purple=u,red=e,white=w,yellow=y
4	bruises	bruises=t,no=f
5	odor	almond=a,anise=l,creosote=c,fishy=y,foul=f, musty=m,none=n,pungent=p,spicy=s
6	gill-attachment	attached=a,descending=d,free=f,notched=n
7	gill-spacing	close=c,crowded=w,distant=d
8	gill-size	broad=b,narrow=n
9	gill-color	black=k,brown=n,buff=b,chocolate=h,gray=g, green=r,orange=o,pink=p,purple=u,red=e, white=w,yellow=y
10	stalk-shape	enlarging=e,tapering=t
11	stalk-root	Bulbous=b, club=c, cup=u, equal=e, rhizomorphs=z, rooted=r, missing=?
12	stalk-surface-above-ring	fibrous=f,scaly=y,silky=k,smooth=s
13	stalk-surface-below-ring	fibrous=f,scaly=y,silky=k,smooth=s
14	stalk-color-above-ring	brown=n,buff=b,cinnamon=c,gray=g,orange=o, pink=p,red=e,white=w,yellow=y
15	stalk-color-below-ring	brown=n,buff=b,cinnamon=c,gray=g,orange=o, pink=p,red=e,white=w,yellow=y
16	veil-type	partial=p,universal=u
17	veil-color	brown=n,orange=o,white=w,yellow=y
18	ring-number	none=n,one=o,two=t
19	ring-type	cobwebby=c,evanescent=e,flaring=f,large=l, none=n, pendant=p, sheathing=s, zone=z
20	spore-print-color	black=k,brown=n,buff=b,chocolate=h,green=r, orange=o,purple=u,white=w,yellow=y
21	population	abundant=a,clustered=c,numerous=n, scattered=s,several=v,solitary=y
22	habitat'	grasses=g,leaves=l,meadows=m,paths=p, urban=u,waste=w,woods=d

The mushrooms and find the relevant species of mushroom. First, I trained the dataset. On that I get 90% accuracy for my project. The dataset breaks to train and validation dataset. After that train the dataset. Training and validation rates start as low rates, and it ends around 90% accuracy

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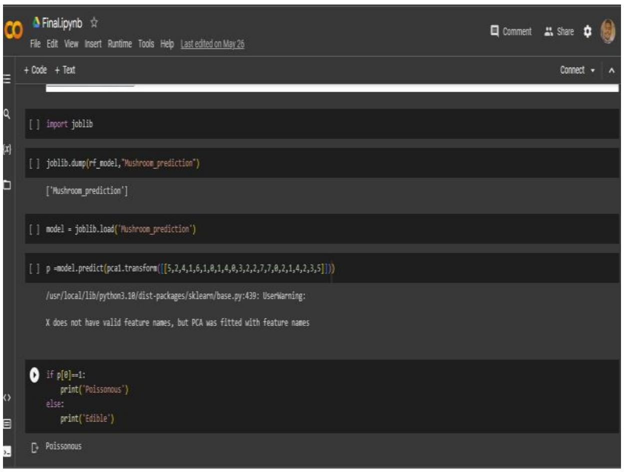

V. CONCLUTION

In conclusion, our research has improved various aspects of mushroom prodution using modern artificial intelligence tech- niques. We have enhanced the identification of using a Convolutional Neural Network (CNN), offering essential data for farmers and market place. With our application we can find the mushrooms species correctly. Every user haven't much knowledge to identify relevant species. they cant identify that species with seen that . so they can identify correctly from this application .And otherwise some sellers sell something . the quality checkers can check the quality of the mushroom is that real species.And on this we can identify growth stage of mushroom. Using CNN model identify relevant growth stage .it identify it can harvest or not .It's important to the farmers harvest the mushrooms

The proper identification of mushrooms, plant pathogenic fungi, and other fungi is an important part of Sri Lankan fungi research. Although several edible and medicinal mushrooms are found in Sri Lanka, most people are afraid to exploit this resource due to a widespread lack of mushroom knowledge. High school and university students, farmers and other local communities in Sri Lanka should be educated through workshops, conferences and guide books on how to safely make use of edible and medicinal mushrooms. If managed properly, the collection and cultivation of edible and medicinal mushrooms can provide a significant boost to rural incomes and nutrition.

Sri Lanka needs both a national fungi herbarium and culture collection, and a strong network of local fungi research groups. It is also vital to have a focal point for mycological activities within the national herbarium capable of managing the identification of all local fungi. Collaboration with other fungi research groups around the world is also vital in order for Sri Lankan scientists to stay abreast of new techniques and discoveries in fungi research. Sri Lankan mycologists should also be recognized for their hard work and persistence in developing this often neglected area of mycology.

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