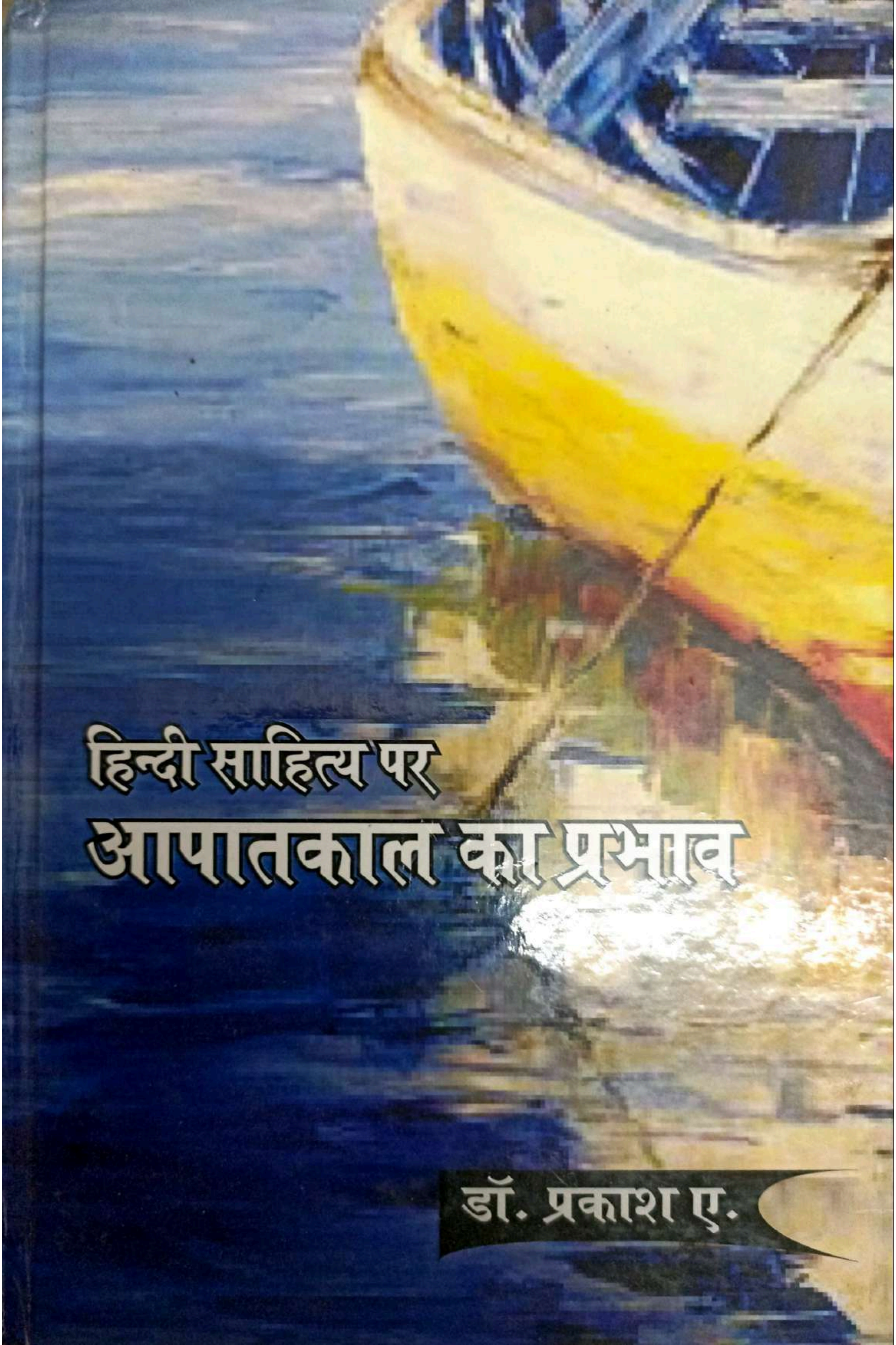

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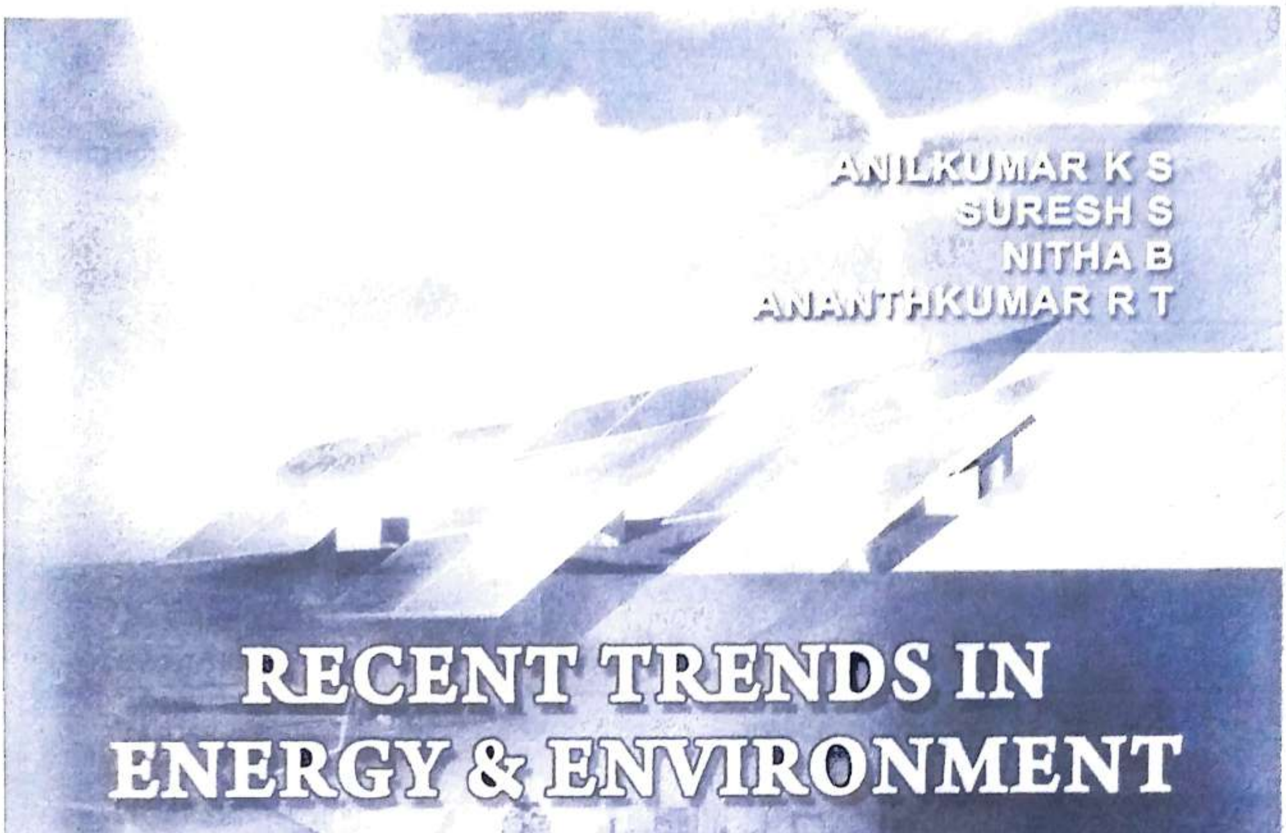
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Breast Cancer Diagnosis using Stacking and Voting Ensemble models with Bayesian Methods as Base Classifiers

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Abstract- **Breast Cancer is a deadly disease affecting mostly women. Despite of many modern techniques Breast Cancer is still alarmingly on the rise and the diagnosis still needs to be improved for timely identification of the disease. A plethora of machine learning techniques have been used in disease diagnosis, risk, recurrence and survivability predictions in the yesteryears, Machine learning models have been used individually and as ensembles for classification and prediction in the medical field. Bayesian Methods provide better classification performance, interpretability and assist in constructing inferences in uncertain conditions. In this study the classification accuracy of single Bayesian Methods- Naive Bayes, Hidden Naive Bayes, Bayesian Belief Networks- in breast cancer diagnosis is analyzed. Bagging, Dagging and Boosting ensemble techniques are applied in conjunction with the Bayesian methods and analyzed. Two Models are proposed . A Stacking model and Stacking-Voting model. In the Stacking model the 3 Bayesian approaches in conjunction with Logistic Regression and Sequential Minimal Optimization as base classifiers and REPTree as meta classifier is used and, in Stacking and Voting - the 3 Bayesian Methods with 2- meta classifiers REPTree and Random Forest , Bayesian Network with Stochastic Gradient Descent and a 2 -meta classifier of REPTree and Decision Stump is proposed and the model performances are evaluated. It was seen that the new proposed ensembles had a better performance than the other models in most cases.**

Keywords: **Naive Bayes(NB), Hidden Naive Bayes(HNB), Bayesian Networks(Bayes Net), Breast Cancer, Ensembles, Logistic Regression(LR), Stochastic Gradient Descent(SGD), Reduced Error Pruning Tree(REPTree), Decision Stump**

I. INTRODUCTION

Breast Cancer etiology is very complex. A variety of factors can be associated with its incidence which influences prediction accuracy. There are various techniques to diagnose breast cancer such as auto exploration, mammography, FNA, ultrasound, MRI and thermography. Despite of progress in diagnostic methods Breast cancer is still one of the leading cancers among women worldwide. Statistical and machine learning techniques can be used in combination as complementary methods in aiding early and better diagnosis. Bayesian methods have found to be effective in dealing with health care evaluation, identifying therapeutic targets[1], risk prediction of breast cancer recurrence [2] and many more.

Classification techniques like decision tree, regression, SVM, ANN have been widely used in the medical field for disease susceptibility prediction, survivability prediction and recurrence prediction [16]. Bayesian approaches are simple robust methods, with wide applicability, using conditional probabilities that help to combine new information with existing information. It helps in better modeling data with uncertainties and missing values.

Bayesian theory is named after the 18th century British mathematician Thomas Bayes. Although he introduced it in 1763 it gained importance in the 1950s and 1960s. Langarizadeh et al [11]in their systemic review of PubMed articles between 2005 and 2016 found in, 23 studies and 53,725 patients, that for predicting disease naive Bayesian networks were used and were effective than other methods such as SVM, Logistic regression, decision trees, ANN, TANs etc. . It can be concluded from various studies that that predictive models are significant approaches in clinical practice and diagnosis. Bayesian methods create a model that links data with parameters and are well suited for decision making. Uncertainties occur due to lack of knowledge of relevant facts. Bayesian methods can quantify these uncertainties using its probability, which is very crucial for decision making. Bayesian models can be combined with more complex models to identify all facts that affects the final results. Studies show that kernel-based classifiers are optimal, and hence Bayes methods, are the most prudent to be chosen as ensemble classifiers[23].

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Breast Cancer Classification using various Back Propagation Algorithms

Tina Elizabeth Mathew[1] and Sreedevi S[2]
[1] Research Scholar, Department of Future Studies, University of Kerala
[2] Associate Professor, Sree Ayappa College Eramallikara

***Abstract*—Cancer also called malignant tumor or malignant neoplasm is one of the world's deadliest diseases. It is the abnormal growth of cells which has the capability of spreading to other parts of the body. Not all tumors are malignant, some are benign and they do not invade surrounding cells. Many models have been used to predict risk of cancer in women but they all represent only a specified group of women, This paper proposes Artificial neural networks using back propagation algorithms for prediction and classification of breast cancer. MLP with various back propagation techniques are tested for providing the most accurate classification.**

***Index Terms*—ANN, BPNN, LM, SCG, GDM, GD, GDA, BFGS, RP.**

I. INTRODUCTION

Early Cancer detection and diagnosis is a most important area of research in the medical field. Breast cancer is the second leading malignancy in women when considering the whole world and the first one in Indian women. Early detection helps in reducing the mortality rate. Conventional methods of diagnosing breast cancer are Mammograms, Breast Ultrasound and MRI . These techniques are expensive and can pose health risks to the patients. All tumors are not malignant some are benign and they do not invade surrounding cells. A safer alternative for classifying tumors can be provided by Artificial Neural Networks thus avoiding complications to the patients.

Classification involves assigning objects into predefined groups or classes based on a number of observed attributes related to those objects. It is a data mining /machine learning technique used to predict group membership for data instances. To simplify the problems of prediction and classification, Artificial Neural Networks(ANN) are used.

ANN's help in nonlinear statistical data modeling by identifying relationships between inputs and outputs. ANN's are adaptive and self organizing in nature and can work robustly in noisy backgrounds. The operations can be carried out in parallel. ANN's employ parameter learning and structure learning for training. In parameter learning, the weights of the connections are updated. The numbers of neurons as well as their connection types are altered in structure learning.

II. RELATED WORK

A. Literature Review

Hamza Turabieh[1] used Neuro Evolution of Augmenting Topologies(NEAT) with Back propagation Neural

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NURTURING THE NEEDED: CANCER AND NATURAL DISASTERS

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Asst. Professor, Department of English, NSS College, Pandalam, Pathanamthitta, Kerala

Introduction

"We cannot stop natural disasters but we can arm ourselves with knowledge: so many lives wouldn't have to be lost if there was enough disaster preparedness".

Cancer has emerged as the most wide spreading disease of the world in recent times. The global cancer burden was estimated to have risen to 18.1 million new cases and 9.6 million deaths in 2018. The increase in the regional burden of cancer is largely a result of socioeconomic growth and the increasing size and aging of the population (Roselle De Guzman2019).

Natural disasters have become frequent phenomena. In such unprecedented situations, the special needs of people with non-communicable diseases including cancer are largely over looked. Cancer patients become an extremely vulnerable group in the midst of the din and bustle of natural disasters.Mostly medical care for disaster-affected population is based on the management of trauma and acute infections. With the increasing number of cancer cases, special attention should be given to the awareness and rehabilitation of cancer patients in the disaster affected areas. There are essentially two factors concerning cancer in association with natural disasters- Cancer risk and Cancer care.

Disasters and cancer risk

Studies have evidenced an association between natural disasters and cancer. Volcanic activity has shown to be a possible risk factor for thyroid cancer. Several studies analyzed the incidence of thyroid cancer among people living in the volcanic areas of Iceland (Hrafnkelsson 1989), Hawaii (Kolonel 1990), New Caledonia (Truong 2007) and French Polynesia (Curado 2007).

The geologic processes of volcanism produce various elements and metals in abnormal concentrations. For example, for decades, Mount Etna has been continuously delivering suspended particulate matter and gases like sulfurdioxide, hydrogenchloride, hydrogenfluoride, hydrogensulfide, hydrochloric acid, sulfuric acid, ammonium sulfate, helium, radon and many of these

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S. V. SUDHEER

UGC-HRDC, University of Kerala
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RESEARCH EXPOSITIONS: Traversing through Multidisciplines
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MULTILAYERED POLYMER CAPSULES FOR CONTROLLED DRUG RELEASE AND APOPTOSIS INDUCED CELL KILLING

Dr. C R Dhanya,

Assistant Professor, Department of Biochemistry, Government College, Kariavattom, Thiruvananthapuram, Kerala

Introduction

One of the major problems encountered in cancer therapy is the poor bioavailability of cancer therapeutic drug at desired site and the toxicity to normal cells. Conventional formulations used for systemic administration of anticancer agents do not give satisfactory therapeutic effect owing to the narrow therapeutic window of these drugs. Extensive research has been undertaken on liposomes, nanoparticles and polymeric micelles for the site directed delivery of chemotherapeutic drug (Moghimi, 2001). Controlled release structures have been formulated to facilitate control of drug exposure over time, to safeguard drug from early elimination, and to guide drug to the desired site of action and at the same time, minimizing drug exposure elsewhere in the body. Polymer capsules comprising hollow nano or microstructures with thin polymeric shells with thickness ranging from few to several hundreds of nanometers have been explored as delivery systems for biomedical applications. Large number of synthetic and biological polymers has been developed for ferrying DNA, proteins, cancer therapeutic drugs etc (De Koker 2011, Javanbakht 2019, Ali 2020).

There are numerous reports on fabrication of multi-compartmental and stimulus responsive polymer capsules engineered by the sequential deposition of oppositely charged materials onto a charged sacrificial template using layer-by-layer (LbL) self-assembly technique and finally removing the core (Tong 2012, Ferjaoui 2020, Wu 2020, Sarode 2020). Several teams have employed LbL technique to synthesize PSS/PAH polymer capsules and explored the possibility of their use in drug encapsulation (Yang 2005). Surface of polymer capsules can be tailored to confer stealth property and targeting attributes. Adding poly ethylene (ethylene glycol) (PEG) to the terminal layer helps the polymer capsules to escape clearance by reticulo endothelial system (RES) (Heuberger 2005, Prajna Mishra 2016). PEG shields the surface of polymer capsules and prevents the adsorption of proteins and thereby enhancing their circulation time (Prajna Mishra 2016, Carlos Sanchez-Cano and Mónica Carril, 2020).

More than 60% of currently used and internationally accepted anticancer agents are either natural products or their derivatives and there are several dietary agents that consist of a wide array of biologically active constituents

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that possess anticancer property (Newman 2007, Reddy 2003). Curcumin or diferuloylmethane, a low-molecular weight polyphenol extracted from the rhizome of *Curcuma longa* is well known for its range of pharmacological properties including antioxidant, anti-inflammatory and anti- proliferative activity (Maheswari 2006). Pre-clinical studies have evidenced the ability of curcumin to inhibit the proliferation of variety of cancer cell types *in vitro* and *in vivo* (Mukhopadhyay 2001, Gong 2012, Anas 2019). In spite of the prospective uses of curcumin, its clinical application has been highly restricted. It is water-insoluble, as a result of which it is poorly absorbed by the gastrointestinal tract. Curcumin is fast metabolized in the liver and is rapidly removed from systemic circulation (Anand 2007). This problem can be overcome by encapsulating curcumin within LbL assembled polymer capsules thereby making it possible to carry the otherwise water insoluble drug to tumor site. This also improves its stability in physiological conditions and protects it from *in vivo* degradation (Mazzarino 2011, Abbas 2015).

Objectives

Major objective is to

- Synthesise PEGylated LbL assembled polymer capsules with alternate PAH and PSS.
- Load polymer capsules with curcumin and to study *in vitro* release behavior of the drug.
- To study the *in vitro* cytotoxicity of drug loaded polymer capsule in A549 human lung adenocarcinoma cells and to study the mechanism of action.

Abbreviations used. LbL, layer-by-layer; PSS, poly (styrene sulphonate); PAH, poly (allylamine hydrochloride); PEG, poly ethylene (ethylene glycol); RES, reticulo endothelial system; SEM, Scanning electron microscopy; MTT, 3- (4,5- dimethyl thiazol-2-yl)-2,5-diphenyl tetrazolium bromide); AO/EB, acridine orange/ethidium bromide; DMEM, Dulbecco's Modified Eagle's Medium; FBS, fetal bovine serum; PBS, phospahate buffered saline; ANOVA, Analysis of variance.

Methods

Preparation and characterization of polymer capsules: Polymer capsules were synthesized and characterized in the Department of Chemical Engineering, IIT Kanpur using established procedure (Yang 2005). Silica core shells were synthesized by Stober's process (Stober 1968). Then eight alternate layers of PAH/PSS and a final layer of PEG were adsorbed alternately on the silica core particles using LbL technique. The silica template was etched out to get

REDEFINING CHILD RIGHTS FOR THE NEW NORMAL SOCIETY

K.M. SAJAD IBRAHIM

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IMPACT OF COVID 19 PANDEMIC ON CHILDREN: ISSUES, CHALLENGES AND REMEDIES

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The entire humanity is reeling under the grip of a tiny, puny virus which has sent the whole world into quarantine. The unprecedented war like situation caused by the spread of pandemic has its repercussions in all walks of human life; economical, social, psychological, cultural etc. Life is no longer the same; human beings are restricted and are banned from their normal routine. When a crisis hits the society, the worst affected will be women and children. Same is the case of Covid 19 pandemic as well. The pandemic had virtually made children prisoners to the four walls of their homes redesigning their childhood.

When the news of the pandemic started oozing out from China, we never, even in our wildest dreams did imagine it is going to create havoc in our day-to-day existence. It slowly made its way to India and we encountered a hitherto unheard situation which is called lockdown. The entire world came to a standstill. People were not allowed to venture outside their homes except on emergency situations. Educational institutes, workplaces, and shops all were shut. The thriving moving population was forced to be within the confines of the four walls of their homes. Those who have not seen their homes during daytime began to enjoy sitting with a cup of coffee watching the sun rise. The lethargy that set in has adversely affected the brimming, buzzing, vibrant section of the society; the children. More than anyone else, children had to go through the traumatic phase of home confinement. There is a complete re-organization of the existing way of living which would take a heavy toll on children.

Issues and Challenges

Its not just viral infection, COVID-19 pandemic has collateral consequences. Children's health is a very important issue to ponder upon under this scenario. Science has demonstrated that environmental factors such as those characteristic of a pandemic can result in modified genetic predispositions. This affects learning capacities, adaptive behaviors, lifelong physical and mental health, and adult productivity (Liubiana Arantes de Araújo 2020).

Child development is adversely affected by the protective confinement, social isolation, and the increased stress level of parents and caregivers during pandemics, like COVID-19 and this becomes an adverse childhood experience (ACEs). This can in turn result in generation of toxic stress, with consequent potential losses for brain development, individual and collective health, and the long-term impairment of cognition, mental and physical health, and working capacity of future adults (Liubiana Arantes de Araújo 2020).

The intensity of toxic stress depends on the care given to the children. If the child is provided with an invariable feeling of security and affection, his/her body restructures biochemically and their physiological functioning restores. Conversely, when this support is insufficient, body functions fail to return to basal level which mostly affects the cardiovascular and neurological systems, there by resulting in irreversible loss of connections in the infant brain, due to toxic stress (Condon 2019).

Structuring of child's brain architecture can be negatively influenced by several factors that have been recognized as ACEs (Hillis 2017). Limited socializing, economic resetting, fear of infection, secluded family life, school closures, peer support, loss of loved ones, the difficulty of tackling working from home along with full-time childcare, financial challenges, other pre-existing vulnerabilities like domestic violence, drug use, and mental illness in family members etc can result in toxic stress (Garner 2012).

Detection and Classification of Banana Leaf diseases using Machine Learning and Deep Learning Algorithms

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***Abstract*--Good yield from banana farms always depend on healthy and disease-free leaves of banana. Hence, it is very essential to detect diseases on time for proper precautions. Manual detection and classification of diseases costs large amount of time and experts' involvement. But implementation of an automated system can help this process within no time. This paper presents three models for banana leaf disease detection and classification using two machine learning approaches, KNN and SVM, and a deep learning approach Alexnet. The Leafspot and Sigatoka are the diseases detected and classified in this work. The RGB colour images are used to train the model to detect and classify the diseased and healthy leaves with and without background. The preprocessed images after data augmentation are used for training the model. The algorithms gave testing accuracies of 76.49%, 84.86% and 96.73% for KNN, SVM and Alexnet respectively.**

Keywords—Dataset, Image Preprocessing, Machine Learning, Deep Learning, KNN, SVM, Alexnet.

I. INTRODUCTION

Bananas are considered as a staple food of India, especially in Kerala. After wheat, rice and maize, banana comes in the fourth position among the most grown crops in the world. India is the largest producer of bananas [1]. India also has a tradition of serving food on banana leaves. Eating food on banana leaves is considered quite healthy and auspicious. Banana leaves contain large amounts of polyphenols that are natural antioxidants, which are found in green tea also. Due to environmental conditions, some fungal and bacterial infections affect the plants, which will in turn reduce the yield. Lack of enough expert availability at the farming field, lack of knowledge in fertilizer management and lack of awareness about diseases and pests decreases the production rate of crops [2]. But nowadays, the production of disease-free banana leaves has increased considerably because of the research works in the area [3]. In this work, two common diseases of banana leaves, leafspot and sigatoka are classified using machine learning and deep learning algorithms.

For the past few years, the computer vision and deep learning algorithms have been making remarkable developments in precision agriculture. Precision agriculture applications aid to detect and classify the diseases and pests and also give awareness to the farmers to recognize the diseases instantly [4], [5]. Early detection and classification of diseases is the major part of precision agriculture [6]. Different machine learning and deep learning algorithms are used to detect and classify the healthy and diseased leaves of the plants with the help of computer vision. The captured images of healthy and different diseased leaves are used to train the model and to classify the leaves. Majority of existing vision-based solutions require high-resolution images with a plain background. In this work, the RGB cameras and computer vision techniques are used to collect the images of leaves. The dataset was evaluated using various classification and object detection techniques to establish the requirements. KNN and SVM classifiers gave a favorable accuracy on the preprocessed dataset, while the deep learning algorithm Alexnet gave better results for classification.

II. RELATED WORKS

Computer Vision and Deep Learning systems are widely used in precision agriculture for quality testing [7], [8] and classification. A mobile phone-based crop disease detection was developed by Sharada *et al.* [9] using deep learning technique. The healthy, BBS and BBW diseases were classified by Owomugisha *et al.* [10] in their work with seven machine learning techniques namely Nearest Neighbors, Decision Tree, Random Forest, Naïve Bayes, Linear Support Vector Machine, RBF SVM and Extremely Randomized Trees. The results of

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Text Pre-Processing Methods on Cross Language Information Retrieval

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***Abstract*—Cross Language Information Retrieval (CLIR), is the process of retrieving relevant documents, where in the language of the given query is different from the language of the retrieved documents. CLIR systems allow the users to search and access documents in the language different from the language of the search query. CLIR systems have been divided into Monolingual CLIR, Bi-lingual CLIR, and Multilingual CLIR based on different languages of query and documents. The first step of the Cross Language Information Retrieval system is the text pre-processing of given text documents in to useful representations. Pre-processing is the set of tasks that convert the given text documents into a suitable format for any higher-level text related applications. This technique can be used to reduce the computational process, noise data, and irrelevant information from the given text documents. This paper discusses in detail the different pre-processing techniques such as dataset creation, tokenization, noise removal, stop word removal, stemming, lemmatization and finally term weighting of two languages dataset (i.e., Tamil and Malayalam), which is manually collected from BBC online website. Finally, the study investigates feature extraction techniques of Term Frequency- Inverse Document Frequency (TF-IDF). These techniques will help to design and model CLIR systems with high performance.**

Keywords—Text pre-processing, CLIR, stemming, Tamil, Malayalam

I. INTRODUCTION

Cross Language Information Retrieval system is a sub area of Information Retrieval (IR) System, in which the query language (Source Language) and language of the documents retrieved (Target language) are different. CLIR is an interdisciplinary field of Information Retrieval, Natural Language Processing (NLP), Linguistics, Machine Translation, Languages and Text Processing. Text pre-processing is the important task that changes the text documents into an appropriate presentation for the any text-based applications [3]. The objectives of the study are to explain what are the different pre-processing techniques followed by text processing and analyse the pre and post impact of text pre-processing in the CLIR model. The various pre-processing techniques on CLIR system, including counting total number of tokens, tokenization, removing URL, removing punctuations, eliminates the stop words, stemming, and TF-IDF are discussed in this paper which is structured as follows: Section II discusses the related studies. The creation of dataset is discussed in section III. The detailed study on text pre-processing in section IV and discussion and conclusion in Section V.

II. RELATED STUDIES

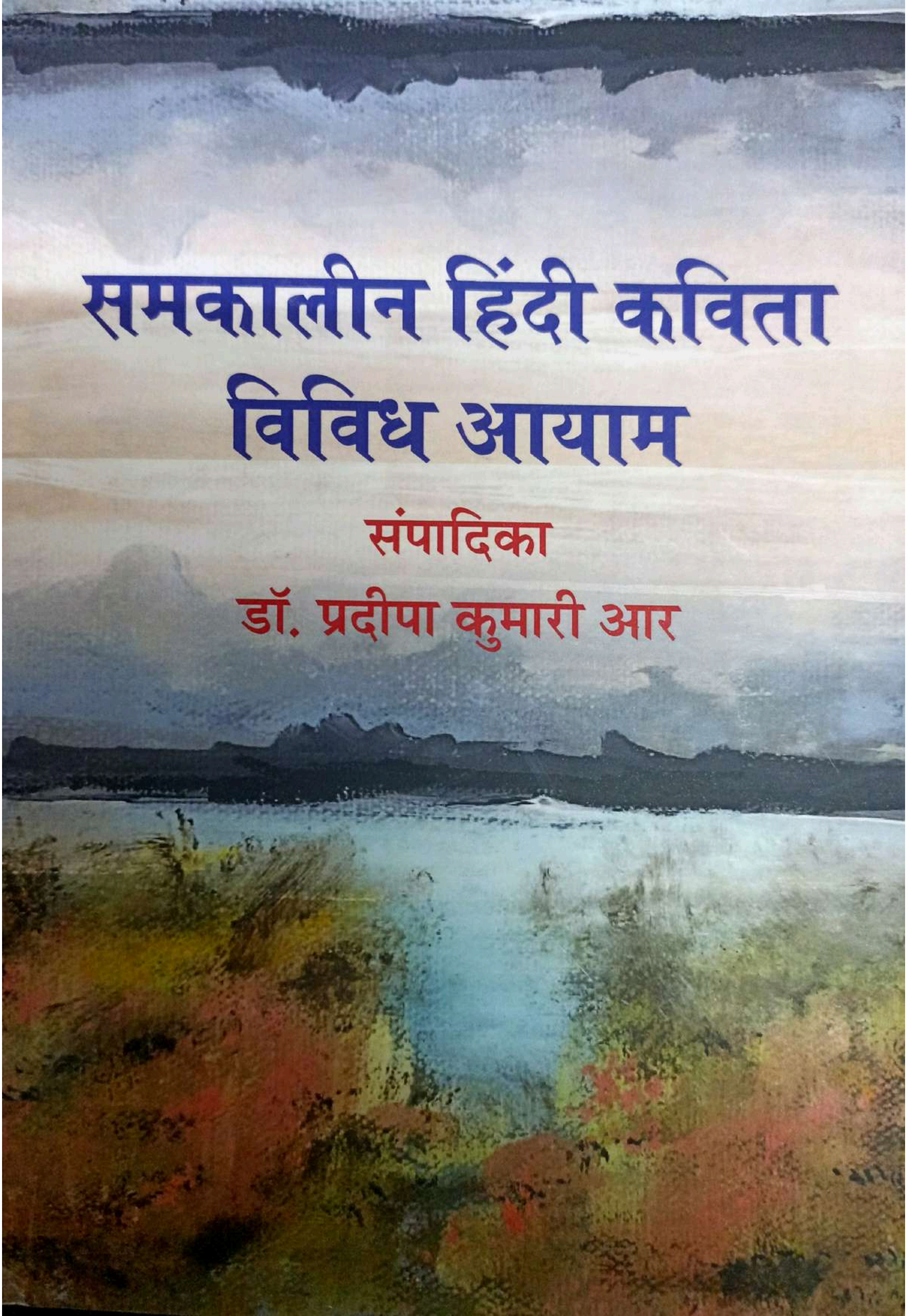
Jianqiang *et al.* [1] evaluated the effects of text pre-processing techniques on sentiment classification performance in different types of classifications tasks. They assessed the following pre-processing techniques such as replacing negative comments, URL, reverting words, numbers and stop words and finally developed n-gram and prior polarity score feature model. Ismael [2] studied several pre-processing tools like tokenization, stop word removal and stemming using BBC English documents classifications. They compared and evaluated with two methods such as chi-square and TF-IDF based on cosine similarity score. The results mentioned that text pre-processing can improve the performance for text classification.

Alhaj *et al.* [3] deliberate the impact of different stemming techniques such as Tashaphyne, ISRI, and ARLStem on collected Arabic Corpus. Three classification algorithms, namely Naïve Bayesian (NB), Support Vector Machine (SVM), and K-nearest neighbor (KNN) were applied to Arabic Corpus. They concluded the effectiveness of SVM over the KNN and NB Classifier, which achieved 94.64 % using K-fold cross-validation method and Micro-F1. Taan *et al.* [4] focused on the performance evaluation of different Information Retrieval models in CLIR system. They also investigated into length of given query and query expansion models for effective retrieval of Quran dataset. The conclusion was that the length of queries has a positive impact on the performance of the retrieval effectiveness.

Vijayarani *et al.* [5] discussed the different techniques of text mining and its pre-processing. The different stemming algorithms (i.e., n-gram, HMM, YASS, Lovins, and Porters) and the limitations are also compared. This paper explained three key steps of pre-processing such as, stop word removal, stemming and TF-IDF model. They listed four types of stop word removal techniques from the given documents such as classic method, Z-method, Mutual Information method (MI), and Term Based Random Sampling (TBRs). Elbagir *et al.* [6] performed a detailed study on sentiment analysis of tweets databased on ordinal regression using machine learning algorithm. The proposed studies were pre-processing of tweets and features extraction methods. They also included many methods for pre-processing tweet such as noise removal, misspelling, case conversations, stop words removal and segmenting the data.

Syafiqah *et al.* [7] proposed an enhanced hybrid feature selection techniques to improve the sentiment classification using machine learning. Mary *et al.* [8] explained various pre-processing phases done on the online documents of Malayalam language. They created two POS-tagged set used for Malayalam documents such as BIS and IIIT-H. The paper concludes that 27% of noise documents are removed after the pre-processing phases.

Fakhrur *et al.* [9] investigated the current status, different challenges and future works of Sentiment analysis for Malay



समकालीन हिंदी कविता विविध आयाम

संपादिका

डॉ. प्रदीपा कुमारी आर

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अनुक्रम

हाशिए का घोषणापत्र

डॉ. प्रकाश ए.

प्रभावोत्पादकता के कारण ही साहित्य में काव्यविधा का स्थान बहुत ऊँचा है। देवेंद्र भारती 'प्रखर' के सम्पादकत्व में निकले'समकालीन हिन्दी दलित कविता– भाग 1'नामक संग्रह में कुल 50 दलित रचनाकारों की कविताएं संकलित हैं, जिनमेंडॉ.संताराम आर्य,हरपाल सिंह'अरुष',आर.जी. कुरील'रसिक', मोहनदास नैमिशराय ,शामलाल राही,सुशीला टांकभौरे जैसे वरिष्ठ कवियों से लेकर अंजली, प्रियंका'हंस',एवं ए.के गौतम् जैसे युवा–पीढी के कवि भी शामिल हैं।प्रस्तुत संकलन के संपादकीय वक्तव्य में 'प्रखर'जी ने पं. महावीर प्रसाद द्विवेदीजी के मंतव्य की याद दिलाया है कि " साहित्य में जो शक्ति छिपी रहती है वह तोप, तलवारऔर बम के गोले में भी नहीं पायी जाती है ।[1] प्रस्तुत संकलन में संग्रहीत कविताओं में अभिव्यक्त भाव और अर्थ की राजनैतिक एवं सामाजिक पृष्ठभूमि के निर्वैयक्तिक एवं तटस्थतापूर्ण विश्लेषण करने पर विदित होता है कि "दलित कविता गैर दलितों को कोसने और गाली देने का माध्यम नहीं है, बल्कि गैर दलितों के सामने अपनी साहित्यिक प्रतिभा को प्रदर्शित करने और दलितों को अपने अधिकारों केलिए संघर्ष करने की प्रेरणा देने का माध्यम है ।"[2] हम औपनिवेशिक दासता से मुक्त होकर आजादी के पचहत्तरसाल की पाँवडी पर खडे हैं।संग्रह की कविताओं के प्रतिपाद्य यही प्रमाण देता है कि यद्यपि भारत के सभी लोगों को अपने नागरिकत्व के बल पर सभी संवैधानिक अधिकार उपलब्ध है फिर भी कुछ लोग इन अधिकारों के व्यावहारिक कार्यान्वयन में असफल होकर हशिए पर चल रहे हैं।

प्रभावोत्पादकता के तौर पर अध्ययनाधीन संकलन दलित साहित्य के प्रतिमानों पर खरी उतरनेवाली कविताओं की विपुलता से समृद्ध एवं सफल होने के साथ भारत के समूचे दलितों की राजनैतिक सोचों को सुमेलित किया गया घोषणापत्र भी है । संग्रहीत कविताओं में मोहनदास नैमिशराय कृत एक कविता का शीर्षक है– 'हाशिए का घोषणापत्र' जिसमें लोकतांत्रिक शासनप्रणाली के माहौल में वाँछित अधिकार एवं पद से वंचित भारत के दलितों की राजनैतिक पहिचान एवं अवधारणा की अभिव्यक्ति दी है।

Pseudo-CT Generation from MRI Images for Bone Lesion Detection using Deep Learning Approach

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Abstract

One of the most reliable MR-based attenuation correction techniques utilised in clinical practice for PET quantification is Magnetic Resonance (MR) image segmentation. The brain cannot be divided into distinct tissue groups since the intensity levels of bone and air signals are so comparable. The purpose of this research is to overcome the issue of attenuation correction, which will allow pseudo-CT images to be generated from MRI data for the diagnosis of bone lesions. The image registration stage has been shifted to the pre-processing stage to do this. The Gray-Level Co-occurrence Matrix (GLCM) and Gray-Level Run-Length Matrix (GLRLM) were discovered to be features. Finally, the UNet++, a deep learning model, which produces the most similar bone areas as depicted in CT scans, has innovatively been used for pseudo-CT creation.

Keywords: Magnetic resonance image (MRI), computed tomography (ct), pseudo-ct, positron emission tomography (pet).

1 Introduction

PET (Positron Emission Tomography) is a well-known imaging method for examining real-time molecular data. The PET acquisition procedure, on the other hand, results in homogeneous bias, lowering image resolution. Attenuation maps are often created from CT images because there is a clear transition between CT intensity and attenuation coefficients [1]. Magnetic Resonance Imaging (MR) is often regarded as the greatest imaging technology for structural brain research due to its superior soft-tissue contrast, high spatial resolution, anatomical and functional information, and lack of ionising radiation. MR images are also used to diagnose, plan therapy, and monitor

Plant Leaf Disease Detection using Computer Vision-A Review

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Abstract:**In an agriculture-based country like India, where economy is mainly based on it, early detection of plant infections is very essential, since it helps agriculturists to apply remedial measures at its emergence itself. This facilitates increased agricultural productivity, which in turn dictates the growth of economy. Though the diseases or pests in plant leaves can be diagnosed by human experts, it is very time-consuming and expensive. Moreover, severity of diseases or pests in farms cannot be accurately predicted. Applying the correct quantity of pesticides in the correct area is an important step in farming. Therefore, Computer Vision assisted detection is a boon for the farmer to reduce time and crop loss. Image detection methods developed by many researchers helped the farmers to speed up the early detection of diseases and facilitates timely intervention for application of suitable medication. This paper reviews the capacities of different methodologies of detecting plant leaf diseases.**

Keywords: Plant Leaf disease detection, Computer Vision, Machine Learning (ML), Deep Learning (DL), Convolutional Neural Networks (CNN)

1. INTRODUCTION

More than 70% of the Indian economy is based on agriculture. Unhealthy cultivation will result in a decline in production and eventually affect the economy. The technologies being used in the agriculture fields are changing drastically and majority of the farmers depend on these technologies for better yield.Computer vision is a technology that uses images of plants for detecting diseases and pests. Each disease of the plant leaves has a unique pattern of mark or lesions, which can be easily diagnosed by experts. To reduce human efforts, researchers have developed several machine learning and deep learning methods to be employed in agricultural fields. The computer vision-based plant diseases and pests' detection technologies have also been applied in agriculture and have replaced the traditional naked eye identification to some extent [1].

When plants become infected, symptoms appear in the form of coloured spots, or streaks that can occur on the leaves, stems, and seeds of the plant. As the disease progresses, changes occur in the colour, shape, and size of these symptoms Since the lesion area is very small compared to the plant background at the initial stage of the infection, it is tedious for the human experts to identify. This is a major challenge in disease and pests' detection. Hence, Computer Vision with machine learning and deep learning methods are now being employed for detection. Collection of a huge number of plant images in all weather and lighting conditions is the first step of this process. In the next step, which is image pre-processing, these images are converted to reduce pixel size, remove background and noise, followed by segmentation, and feature extraction. Image processing algorithms can be used for these tasks. Different architectures of Convolutional Neural Networks(CNN), which is a type of artificial neural network(ANN),have been developed and effectively applied for detection of pests and diseases. CNNs have powerful image processing capabilities often using deep learning and machine learning techniques for image classification and video recognition.

2. RELATED WORKS

The plant leaves disease and pest detection can be done through a course of action. The initial step is to collect images which is public or to collect directly from farms. The images are divided into two groups; training and testing after some pre-processing techniques and labelling. Finally, a novel architecture with high accuracy is to be developed to classify and identify the diseases or pests. Because of its relevance, many works have been done in this field.

Most of the papers have used the public dataset, the PlantVillage. 54306 images of 14 crops from this dataset was used by Sharada P. Mohanty *et. al* [2]. These images were labelled with 38 class labels; 26 diseases and 12 healthy leaves. The images were resized as 256 x 256 pixels and were converted to Gray scale colour model. Two CNN architectures, AlexNet and GoogleNet were employed to classify the classes. From the Colour, Gray scale and leaf segmented datasets, the training-testing set were distributed as 80% – 20%, 60% – 40%, 50% – 50%, 40% – 60% and 20% – 80%. For 80% -20% set, the accuracy of AlexNet was 85.53% and that of GoogleNet was 99.34%. But it reduced to 98.21% for 20% -80% set of GoogleNet, and the study concluded that GoogleNet architecture outperform AlexNet.

Detection and Classification of Banana Leaf diseases using Machine Learning and Deep Learning Algorithms

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***Abstract*--Good yield from banana farms always depend on healthy and disease-free leaves of banana. Hence, it is very essential to detect diseases on time for proper precautions. Manual detection and classification of diseases costs large amount of time and experts' involvement. But implementation of an automated system can help this process within no time. This paper presents three models for banana leaf disease detection and classification using two machine learning approaches, KNN and SVM, and a deep learning approach Alexnet. The Leafspot and Sigatoka are the diseases detected and classified in this work. The RGB colour images are used to train the model to detect and classify the diseased and healthy leaves with and without background. The preprocessed images after data augmentation are used for training the model. The algorithms gave testing accuracies of 76.49%, 84.86% and 96.73% for KNN, SVM and Alexnet respectively.**

Keywords—Dataset, Image Preprocessing, Machine Learning, Deep Learning, KNN, SVM, Alexnet.

I. INTRODUCTION

Bananas are considered as a staple food of India, especially in Kerala. After wheat, rice and maize, banana comes in the fourth position among the most grown crops in the world. India is the largest producer of bananas [1]. India also has a tradition of serving food on banana leaves. Eating food on banana leaves is considered quite healthy and auspicious. Banana leaves contain large amounts of polyphenols that are natural antioxidants, which are found in green tea also. Due to environmental conditions, some fungal and bacterial infections affect the plants, which will in turn reduce the yield. Lack of enough expert availability at the farming field, lack of knowledge in fertilizer management and lack of awareness about diseases and pests decreases the production rate of crops [2]. But nowadays, the production of disease-free banana leaves has increased considerably because of the research works in the area [3]. In this work, two common diseases of banana leaves, leafspot and sigatoka are classified using machine learning and deep learning algorithms.

For the past few years, the computer vision and deep learning algorithms have been making remarkable developments in precision agriculture. Precision agriculture applications aid to detect and classify the diseases and pests and also give awareness to the farmers to recognize the diseases instantly [4], [5]. Early detection and classification of diseases is the major part of precision agriculture [6]. Different machine learning and deep learning algorithms are used to detect and classify the healthy and diseased leaves of the plants with the help of computer vision. The captured images of healthy and different diseased leaves are used to train the model and to classify the leaves. Majority of existing vision-based solutions require high-resolution images with a plain background. In this work, the RGB cameras and computer vision techniques are used to collect the images of leaves. The dataset was evaluated using various classification and object detection techniques to establish the requirements. KNN and SVM classifiers gave a favorable accuracy on the preprocessed dataset, while the deep learning algorithm Alexnet gave better results for classification.

II. RELATED WORKS

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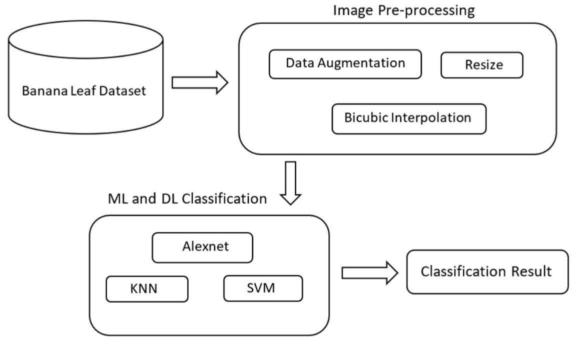
these classifiers were analyzed using ROC AUC score. All classifiers gave good AUC score in each class. Jihen Amara *et al.* [11]'s LeNet CNN architecture classifies 3 classes of banana leaves with accuracy 99.72%. The manually annotated 3700 images were used with different training-testing ratio, and the colour image inputs gave better accuracy than Gray-scale images. 18000 banana leaf images were used by Michel Gomez Selvaraj *et al.* [12] to classify the healthy and 5 different diseases of Banana leaves. The authors reported an accuracy of 88.88% for ResNet50, 88.83% for InceptionV3 and 81.76% for MobileNet architecture. A. Athiraja *et al.* [13] reported ANFIS architecture outperformed Machine learning architectures for classification of banana leaves and Ani Brown Mary N *et al.* [14] used K-means and HEAP auto Encoder (HAE) to classify 6471 images which were from 4 different datasets; Scotnielson, Godliver, PlantVillage and Realtime. They concluded their study with accuracies 99.42% for Scotnielson, 98.69% for Godliver, 98.42% for PlantVillage, and 99.35% for Realtime datasets. SVM and Random Forest machine learning techniques and AlexNet and GoogleNet CNN architectures were used by Mohammed Brahimi *et al.* [15] to classify healthy and diseased plant leaves, and Alexnet model achieved 98.66% accuracy. The papaya leaves were classified by S. Ramesh *et al.* [16] using SVM and KNN and resulted in accuracies of 40.33% and 66.76%. K. Ahmed *et al.* [17] achieved 91.66% accuracy in KNN model to classify rice leaves diseases. M. Arsenovic *et al.* [18] and M. Turkoglu *et al.* [19] used Alexnet model for plant diseases classification and achieved 81.24% and 86.94% accuracies respectively.

III. PROPOSED METHOD

The proposed method creates three models which could classify Banana leaves as healthy, Leafspot and Sigatoka, using KNN and SVM machine learning algorithms and Alexnet Deep Learning algorithm. The architecture of the proposed method is shown in Fig. 1.



Fig, 1. Architecture of the proposed method.

A. The Dataset

The dataset used in this study contains 12544 banana leaf images after data augmentation. The dataset of infected and healthy banana leaves was created by collecting the images from different banana farms under Krishibhavan, Kazhakuttam, Trivandrum, Kerala, India using simple camera devices. The images are in different resolutions and have different infected areas of leaves. The plant sizes are also different. The change of climate also reflected in the images. 278 Healthy leaf images, 296 Leafspot disease images and 543 Sigatoka disease images were collected from farms of Krishibhavan. The images were of different sizes. In addition to the captured images, images from the public datasets, GitHub (https://github.com/godliver/source-code-BBW-BBS), Scot Nelson Flickr (https://www.flickr.com/search/?text=bananaleafdisease), were also used to create the dataset. 653 Healthy leaf images, 631 Leafspot disease images and 696 Sigatoka disease images were used from these public datasets. Total 4353, 4154, 4037 images for Healthy, Leaf Spot and Sigatoka classes (Fig. 2) were used to train the model after augmentation. Leaves infected with these diseases usually exhibit visible marks or lesions on it. Generally, each disease has its own visible pattern to recognize and diagnose the anomaly. Different phases such as early, medium and last phases, of each disease are also included in the dataset. The diseases of the dataset are detected and categorized by visual inspection of experts or by conducting laboratory tests on leaves. The accuracy of the models depends on the quality of the dataset and its labeling.

(a) (b) (c)

Fig. 2. (a) Healthy Banana Leaf (b) Leafspot (c) Sigatoka

B. Image Preprocessing

The images in the dataset are in RGB color space. Data augmentation techniques such as flipping, rotating, zooming, clipping was applied in each image (Fig (3)). These data augmentation techniques help to avoid overfitting of the model. Though the deep learning algorithms have overfitting problem, they outperform the machine learning algorithms [20]. The images are resized to 32x32 for KNN classification, 150x150 for SVM classification, and 227x227 for Alexnet [21] dataset training. This dataset resize process helps to reduce the training time of each algorithm. Then the non-adaptive

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Keywords: Plant Leaf disease detection, Computer Vision, Machine Learning (ML), Deep Learning (DL), Convolutional Neural Networks (CNN)

1. INTRODUCTION

More than 70% of the Indian economy is based on agriculture. Unhealthy cultivation will result in a decline in production and eventually affect the economy. The technologies being used in the agriculture fields are changing drastically and majority of the farmers depend on these technologies for better yield.Computer vision is a technology that uses images of plants for detecting diseases and pests. Each disease of the plant leaves has a unique pattern of mark or lesions, which can be easily diagnosed by experts. To reduce human efforts, researchers have developed several machine learning and deep learning methods to be employed in agricultural fields. The computer vision-based plant diseases and pests' detection technologies have also been applied in agriculture and have replaced the traditional naked eye identification to some extent [1].

When plants become infected, symptoms appear in the form of coloured spots, or streaks that can occur on the leaves, stems, and seeds of the plant. As the disease progresses, changes occur in the colour, shape, and size of these symptoms Since the lesion area is very small compared to the plant background at the initial stage of the infection, it is tedious for the human experts to identify. This is a major challenge in disease and pests' detection. Hence, Computer Vision with machine learning and deep learning methods are now being employed for detection. Collection of a huge number of plant images in all weather and lighting conditions is the first step of this process. In the next step, which is image pre-processing, these images are converted to reduce pixel size, remove background and noise, followed by segmentation, and feature extraction. Image processing algorithms can be used for these tasks. Different architectures of Convolutional Neural Networks(CNN), which is a type of artificial neural network(ANN),have been developed and effectively applied for detection of pests and diseases. CNNs have powerful image processing capabilities often using deep learning and machine learning techniques for image classification and video recognition.

2. RELATED WORKS

The plant leaves disease and pest detection can be done through a course of action. The initial step is to collect images which is public or to collect directly from farms. The images are divided into two groups; training and testing after some pre-processing techniques and labelling. Finally, a novel architecture with high accuracy is to be developed to classify and identify the diseases or pests. Because of its relevance, many works have been done in this field.

Most of the papers have used the public dataset, the PlantVillage. 54306 images of 14 crops from this dataset was used by Sharada P. Mohanty *et. al* [2]. These images were labelled with 38 class labels; 26 diseases and 12 healthy leaves. The images were resized as 256 x 256 pixels and were converted to Gray scale colour model. Two CNN architectures, AlexNet and GoogleNet were employed to classify the classes. From the Colour, Gray scale and leaf segmented datasets, the training-testing set were distributed as 80% – 20%, 60% – 40%, 50% – 50%, 40% – 60% and 20% – 80%. For 80% -20% set, the accuracy of AlexNet was 85.53% and that of GoogleNet was 99.34%. But it reduced to 98.21% for 20% -80% set of GoogleNet, and the study concluded that GoogleNet architecture outperform AlexNet.

The CaffeNet architecture was used by SrdjanSladojevic*et. al* [3] with 15 class labels of 33,469 images, of which 30880 images were train images and 2589, test images. These public images were resized as 256 x 256 pixels to reduce the time consumption. 13 diseases of 6 crops were classified in this model. The prediction of the model was evaluated by 10-fold cross validation technique. By applying fine tuning methods, the effectiveness of the model increased with an accuracy of 96.3%.

Maize leaves infection classification was done by Chad Dechant*et. al* [4] in their study on public images of Maize leaves. 1769 images were used to detect the fungal infection of the leaves. The training of the CNN model was in 3 stages in the ratio 70-15-15 of 224 x 224-pixel images. The 15% validation set was used to validate the model after the second stage. The heat maps of the images were used in the third stage and the study concluded with an overall accuracy of 96.7%.

Alvaro Fuentes *et. al* [5] and Mohammed Brahimi *et. al* [6] used different CNN architectures to detect the 9 diseases of Tomato leaves. They employed three Deep Meta architectures, Faster R-CNN, R-FCN, and SSD and also feature extractors [5]. This model aimed to detect the disease type and the location of the disease in every leaf. They trained the model with 5000 images (43398 labels) and 80% of labels were used for training, 10% for testing and the remaining 10% for validation to minimize overfitting. The model gave an accuracy of 83% for Faster R-CNN, 85% for R-FCN and 82% for SSD. It was also concluded that R-FCN gave the better result with feature extractors and without data augmentation the accuracy was only 55.64%.

14828 images from PlantVillage were used to classify 9 diseases of tomato leaf [6]. The deep models; AlexNet and GoogleNet outperformed Shallow models; SVM and Random Forest. The models gave an accuracy of 98.66% for AlexNet ,99.185% for GoogleNet by using pre-training data and 97.354% and 97.711% without pre-training. The accuracy for the Shallow models of SVM and RandomForest were only 94.538% and 95.467%.

Guan Wang *et. al* [7] used VGGNet, Inception-V3, and ResNet50 to analyse 4 stage diseases of apple leaves. The aim of the model was to evaluate healthy and black rot leaves of apple tree. 2086 images were used from PlantVillage dataset. The images were resized as 224 x 244 pixels for VGG and 299 x 299 for Inception-V3. SGD training algorithm was used for learning with learning rate of 0.01 and 10 epochs. SGD and RMSP algorithms were used for Transfer learning with learning rate of 0.0001 and 0.01 respectively and for 10 epochs. The model gave 90.4% accuracy for VGG16 architecture.

Healthy and diseased Banana leaves were predicted by Jihen Amara *et. al* [8]'s LeNet CNN architecture with accuracy 99.72%. The manually annotated 3700 images were divided into 5 sets with different training-testing ratio; In the experiment, the colour image inputs gave better accuracy than Gray scale images.

58 Classes of 25 crops; 38 diseases and 20 healthy leaves were used by Konstantinos P. Ferentinos [9] to analyse 87,848 images. The publicly available input images were resized as 256 x 256 pixels for classification. The CNN architectures AlexNet, AlexNetOWTBn, GoogleNet, Overfeat, and VGG models were used to classify the two trainsets 80% and 70%. The reported success rates of different models were: AlexNet – 99.06%, AlexNetOWTBn – 99.44%, GoogleNet- 97.27%, Overfeat – 98.96%, and VGG – 99.48%.

Around 500 images of diseased and healthy tomato leaves were used by MelikeSardogan*et. al* [10] to predict the diseased leaf. CNN model with Learning Vector Quantization (LVQ) algorithm was used to identify and classify the 4 class labelled images. The PlantVillage dataset was taken as input images, and resized to 512 x 512. The image dataset was split into 400 and 100 as training - testing pair for the model. The model showed an average accuracy of 86% for five classes.

Shima Ramesh *et. al* [11] proposed a methodology for Papaya leaves classification. Histogram of an Oriented Gradient (HOG) was used for feature extraction of 160 images of Papaya leaves after pre-processing techniques; reduction of the size and conversion of RGB to grayscale. Random Forest, Logistic Regression, SVM, KNN, CART, Naïve Bayes were used for classification of the model which gave accuracies of 70.14%, 65.33%, 40.33%, 66.76%, 64.66% and 57.61% respectively.

VGG16, Inception V4, ResNet50, ResNet101, ResNet152, and DenseNet121 architectures were used by Edna Chebet Too *et. al* [12] to classify 54306 images of 14 crops. The images were from PlantVillage dataset and resized as 224 x 224 for VGG16, ResNet50, ResNet101, ResNet152, DenseNet121 architectures and to 299 x 299 for Inception V4. RGB colour variations and two training and testing combinations were used in the study. 80%-20% ratio and 34727-8702-10876 for training-validation-testing sets were used to classify the model. Different fine-tuning techniques were applied in the architecture which resulted in an accuracy of 99.75% for DenseNet. The conclusion from the study is that DenseNet121 architecture is the most appropriate for the image-based disease detection of plants.

From UCI Machine Learning Repository Kawcher Ahmed *et. al* [13] took 480 Rice leaves to classify 3 types of diseases. These prominent and dangerous rice diseases were analysed and classified by using Logistic Regression, KNN,

Image-Based Plant Leaf Disease Detection and Classification using Deep Learning Models

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Abstract

Early detection of plant leaf diseases is beneficial as it helps agriculturists to apply remedial measures well in advance. This is highly recommended for a good yield from crops, which enhances the economy of an agriculture-based country. Computer Vision and Deep Learning techniques, used in the field of precision agriculture facilitate early detection of plant leaf diseases. Literature proclaim that deep learning models outperform the machine learning approaches for classification of leaf diseases. In this paper, the state-of-the-art deep learning methods for detection and classification are applied on banana leaf dataset. The AlexNet, VGG19, DenseNet201, ResNet50, and MobileNetV2 Convolutional Neural Networks are the models compared in this paper. The real time images of banana leaves are used to train and test these models' using python. Healthy and two common diseases of banana leaves are classified in this work. After data augmentation and preprocessing, all the models could achieve good testing accuracies of more than 90.6% in the 80-10-10 training-validation-testing set.

Keywords

Plant Disease, Image Pre-processing, Data Augmentation, Computer Vision, Deep Learning.

1. Introduction

Plants are usually affected by many diseases and proper precautions are needed for better results in the farming field. The main reason for infection of plant leaves is the seasonal change in climate and it adversely affects the crop yield. The unavailability of expert's opinion about the farming and less knowledge about diseases and fertilizer management will also affect the yield [1]. This will lead to ecological imbalance and economic insecurity of the nation. The diseases of the plants start from minor symptoms to serious damage of the whole plant. Hence, early detection of diseases is highly crucial and is the aim of disease classification [2].

Computer Vision with deep learning techniques have a great impact on precision agriculture especially in object detection and recognition [3]. The automated plant disease detection will help for an error free classification of diseases in less time. Huge number of real time images are collected and trained to give an optimal solution at minimal cost. Various machine learning and deep learning algorithms are used to detect and classify the diseases and also to provide proper guidance to the farmers for recognition [4]. In terms of scale of production and marketing, banana is the one of the important crop fruits in the world [5]. The diseases and pests in the leaves of banana affects the production landscapes and global food security of the world. Timely intervention for remedial actions is the result of early identification of a crop disease and will have less impacts on food supply chains. The proposed work uses healthy and diseased banana leaves images to train AlexNet, VGG19, ResNet50, DenseNet201 and MobileNetV2 deep learning models. The two common diseases of banana leaves considered in this paper are Leafspot and Sigatoka. The objective of this work is to apply image pre-processing techniques on RGB based banana leaves and to classify the leaves using deep learning approaches. All deep learning models of this work gave more than 90.6% accuracy and good precision, recall and f1-score values in the 80% of training set. The AUC is 0.98, 0.99 and 1 in all models of the three classes. Selection of the appropriate model for disease detection and classification greatly depends on the accuracy [6].

2. Related Works

Many works have been done in the field of farming technology and precision agriculture because of the relevance of plant leaf disease detection and classification. For quality testing automated systems are widely used in precision agriculture [7], [8]. 14 crops' disease detection and classification were done by S. P. Mohanty et al. [9] and E. C. Too et al. [10] in their work using different deep learning techniques such as AlexNet, GoogleNet, DenseNet121, Inception V4, ResNet50, ResNet101, ResNet152, and VGG16 and achieved more than 85% accuracy. Nine diseases of the tomato leaves were classified by M. Brahimi et al. [11] using AlexNet and GoogleNet with 99% accuracy. K. P. Ferentinos [12] got 99% accuracy using the AlexNet model by classifying 25 crops' classes. M. G. Selvaraj et al. [13] proposed the models with ResNet50, InceptionV2, MobileNetV1 and achieved up to 88.88% accuracy for banana leaves' disease classification. ResNet50 and AlexNet algorithms were used by H. Ajra et al. [14] to classify potato and tomato leaves in different training testing combinations. Tea leaves were classified by G. Hu et al. [15] using VGG16 and gave only 72.5% with 398 images. The accuracy greatly depends on the data size taken. Six classes of wheat leaves were classified by T. Hayit et al. [16]. VGG16 and VGG19 deep learning models gave an accurate classification system for classification of potato leaves [17] and grapes leaves [18]. The EfficientNet algorithm models are outperforms the other deep learning methods in original and augmented image datasets [19]. The SqueezeNet mobile deep learning classification by H. Durmus et al. [20] achieved better results than AlexNet due to its lightweight and low computational needs. The PlantVillage dataset was used to train the deep network models in most of the researches [21].

3. Materials and Methods

The proposed method creates five models which could classify banana leaves as Healthy, Leafspot, and Sigatoka using AlexNet, VGG19, DenseNet201, ResNet50, and MobileNetV2 deep learning algorithms. The architecture of the proposed work is depicted in the Figure 1.

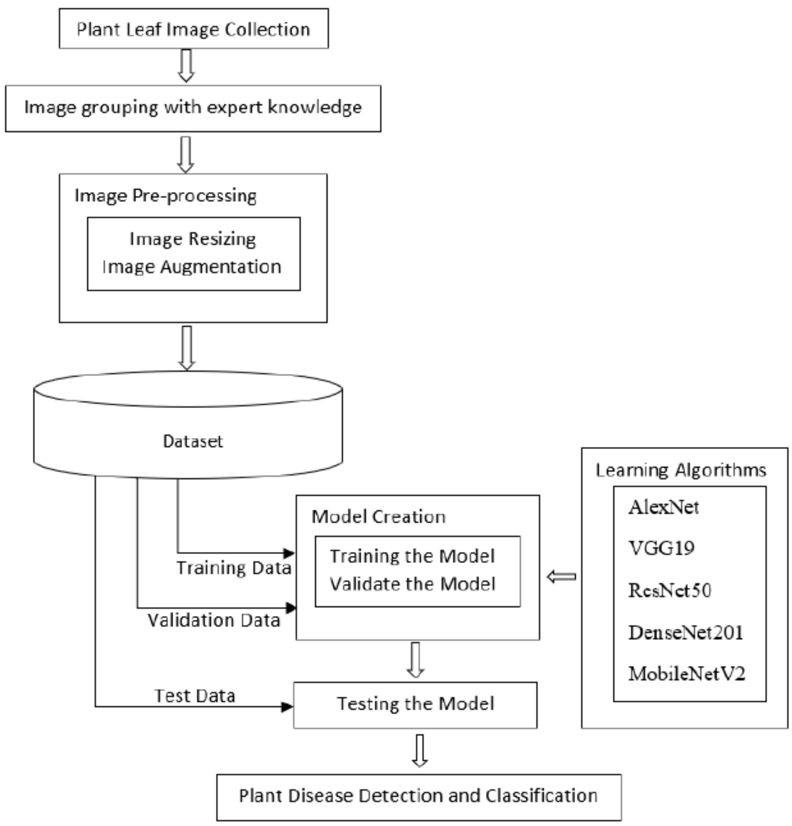

Figure 1: Architecture of Plant Leaf Classification Methodology

Finetuned-VGG16 CNN Model for Tissue Classification of Colorectal Cancer

T. E. Anju and S. Vimala

Abstract Classifying cancer tissues has been a difficult task ever since Computer Vision and Pattern Recognition were developed. Deep Learning, a modern, state-of-the-art method for texture categorization and localisation of cancer tissues, has replaced traditional machine learning approaches. The third leading cause of mortality from cancer globally is colorectal cancer. In this paper, a fine tuned deep learning model is proposed for image-level texture based classification using CRC dataset. In order to minimise overfitting and considerably increase classification accuracy, the model must be fine-tuned, especially when there are less set of training datasets available. The VGG-16 pretrained model underwent fine-tuning. The nine classes of the histology Kather CRC image collection were used to verify these models (CRC-VAL-HE-7K, NCT-CRC-HE-100K). The outcomes demonstrated that the accuracy of histopathological image recognition was much higher than that of previous approaches.

Keywords Convolution neural network · Colorectal cancer (CRC) · Deep learning · Visual geometry group (VGG) 16 · Tumor epithelium · Densenet

1 Introduction

One in nine women may get breast cancer over their lifetime, which is a serious disease. According to polls, 1 in 32 women will develop breast cancer and pass away from it. The second-largest category of new cancer cases in 2018 was predicted to be breast cancer, which would account for almost 1 in 4 instances of cancer discovered in women. Breast cancer is the seventeenth most important cause of death worldwide and the biggest risk factor for cancer in women. The third most prevalent malignancy, colorectal cancer (CRC), is closely correlated with our way of life. When polypectomy screening tests are conducted, the death rate of CRC patients is markedly reduced. Experts are required to examine several polyp instances during

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the CRC screening test in order to find problematic tissues [1–3]. Cancer researchers will use artificial intelligence (AI) to detect the disease's symptoms and choose the best course of therapy. It will expedite diagnosis and increase its effectiveness. Better treatment options might lower cancer patients' mortality as a result of the information that is gained. The AI discipline of deep learning (DL) was originally developed in the 1990s [4, 5]. Numerous methods for recognising patterns and images have been presented, and more recently, computer vision has advanced to make use of deep convolutional neural networks (CNN) [4]. Instances of deep CNN models based on ImageNet weights [6] were created at this time, introducing advances like Xception [7], VGG-16 [8], etc.

By finetuning the CNN models in parameters such as the Dropout Layer, Learning Rate, and Validation Frequency, overfitting is reduced and improves classification performance both in VGG-16 and DENSENET. We investigate the efficiency of differentiating tumour epithelium from stroma utilising transfer learning approaches. The remainder of this paper is structured as follows. The related work of optimising Deep CNN models is covered in Sect. 2. The Learning Rate, Dropout Layer, and Validation Frequency are adjusted in Sect. 3, to present our suggested methodology. Section 4 then presents the experimental findings. Finally, Sect. 5 provides the conclusion.

2 Literature Review

Using deep learning and image processing approaches, researchers from all over the world have been working diligently to establish reliable frameworks and processes for the rapid and accurate identification of cancer. However, none of those approaches has been successful in accurately forecasting cancer. As a result, histopathology WSI for cancer diagnosis has gained popularity recently. Since the middle of the 1990s, CNNs have been utilised in medical imaging to detect various disorders [9, 19]. Since then, CNN architectures have primarily been used for a variety of tasks in the field of medical image analysis. Despite their progress in identifying medical pictures, CNNs still face a number of challenges. The first and most significant challenge is the potential for overfitting the model, which results from overly deepening of tumour classification networks, which quickly increases the training parameters. The probability of overfitting must also be reduced by using many image samples, however this is not always feasible. Hyperparameters, which are essential to a CNN's effective functioning, is the second challenge. The learning rate is a crucial hyperparameter that has the ability to make or destroy a model. It is necessary to manually alter the model's learning rate in line with the progress of the training in order to ensure that the model operates at its peak throughout [10]. For CRC image analysis jobs, Linder et al. [11] recommended the CRC analysis utilising conventional data mining approaches. The automatic classification method was used to distinguish the tumour stroma from the tumour epithelium in digitised tumour tissue microarrays (TMA). The support vector machine (SVM) and local binary patterns (LBP)

കാഴ്ച കണ്ണിന്റെയോ തലച്ചോറിന്റെയോ
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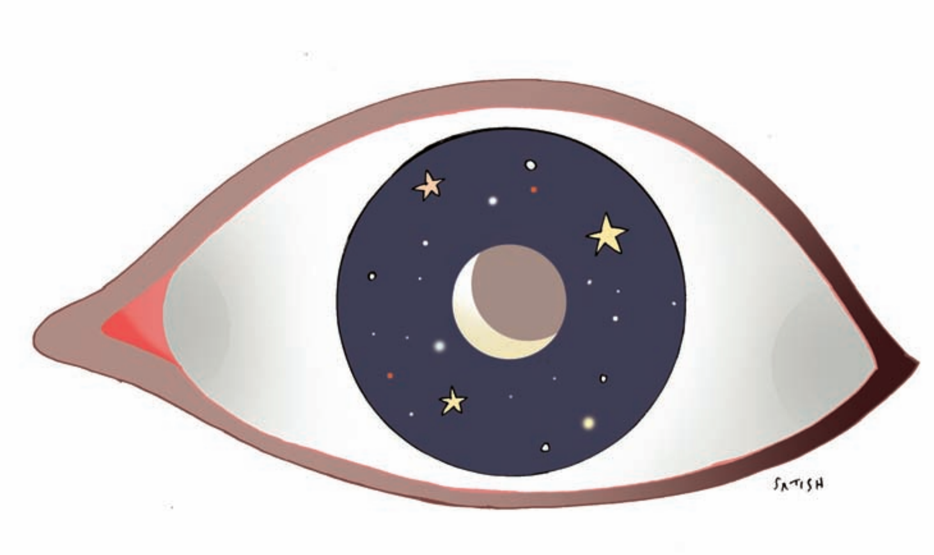

കണ്ണുകളുടെ വൈവിധ്യവും പരിണാമവും

ഡോ. രാഹുൽ സുബിൻ എസ്.

- തലച്ചോറ് കഴിഞ്ഞാൽ ഏറ്റവും സങ്കീർണ്ണമായ ഘടനയും വികാസവും ഒത്തുചേർന്ന അവയവമായ കണ്ണുകളുടെ വൈവിധ്യത്തെക്കുറിച്ചും അതിന്റെ പരിണാമത്തെക്കുറിച്ചും വിവരിക്കുന്നു.
- സൂക്ഷ്മാണുക്കളിൽ കണ്ടിരുന്ന ഐ സ്പോട്ട് വികസിച്ചു പ്രകാശ പ്രതികരണശേഷിയുള്ള കോശങ്ങളുടെ ഒരു പ്ലാറ്റ്ഫോം രൂപമെടുത്ത് ബഹുകോശ ജീവികളിൽ പിമെന്റ് സ്പോട്ട് ആയി മാറിയ പരിണാമ വഴികൾ പരിചയപ്പെടുത്തുന്നു.
- വ്യത്യസ്ത ജീവിവർഗങ്ങളിൽ അവയുടെ ചുറ്റുപാടുകൾക്കനുസരിച്ചും ഇരതേടുന്നതിനുമായി കണ്ണുകൾ പ്രത്യേകമായി പരിണമിച്ചതിന്റെ ഉദാഹരണങ്ങൾ ചൂണ്ടിക്കാണിക്കുന്നു.

ജീവജാലങ്ങളിലെ ഏറ്റവും സങ്കീർണ്ണമായ അവയവങ്ങളിൽ ഒന്നാണ് കണ്ണ്. കണ്ണുകളുടെ ശരിയായ പ്രവർത്തനത്തിന് അതിന്റെ എല്ലാ ഭാഗങ്ങളും അത്യന്താപേക്ഷിതമാണ്. പ്രീബയോട്ടിക് ഭൂമിയിൽ (prebiotic earth), കാഴ്ചശക്തി ജീവികൾക്ക് അത്യാവശ്യമല്ലായിരുന്നു. അതുകൊണ്ടുതന്നെ, കാഴ്ചശക്തി പരിണാമത്തിന്റെ തുടർച്ചയാണെന്നും ക്രമേണ ഒഴിച്ചുകൂടാനാവാത്തതായി മാറുകയായിരുന്നെന്നും കണക്കാക്കാം. നൂറ്റാണ്ടുകളായി കണ്ണുകളുടെ വൈവിധ്യത്തെക്കുറിച്ചും അതിന്റെ പരിണാമത്തെക്കുറിച്ചും മനുഷ്യൻ പഠിച്ചുകൊണ്ടിരിക്കുന്നു. നേത്രപരിണാമം വളരെ രസകരവും ബൃഹത്തുമായ വിഷയമാണ്.

മൃഗങ്ങൾ അവരുടെ നിലനിൽപ്പിനു വേണ്ടി വിദൂര സാഹചര്യങ്ങളെ അനുഭവവേദ്യമാക്കുന്ന (distance senses) മൂന്ന് ഇന്ദ്രിയങ്ങളെകാഴ്ച, കേൾവി, ഗന്ധം, ആണ് ആശ്രയിക്കുന്നത്. മേല്പറഞ്ഞ ഇന്ദ്രിയങ്ങളിൽ കാഴ്ചശക്തിക്കാണ് വളരെ ദൂരെയുള്ള കാര്യങ്ങൾ മനസ്സിലാക്കാൻ കഴിവ് കൂടുതലുള്ളത്. നമ്മുടെ നേത്രങ്ങൾകൊണ്ട് ആയിരകണക്കിന് പ്രകാശവർഷങ്ങൾ അകലെയുള്ള നക്ഷത്രങ്ങളെവരെ കണ്ടുപിടിക്കാൻ കഴിയും. അതായത്, നമ്മുടെ കണ്ണിലെ റെറ്റിനൽ കോശങ്ങളെ ഉത്തേജിപ്പിക്കുവാൻ ഒരു ഫോട്ടോൺ (photon) കണിക മതിയാകും എന്നുള്ളത് കാഴ്ചശക്തിയുടെ മേധാവിത്വം തെളിയിക്കുന്നു. മൃഗങ്ങൾക്ക് വളരെ ദൂരെ നിന്ന് ആഹാരം കണ്ടെത്തുവാനും ഇരയ്ക്ക് (prey) വേട്ടക്കാരിൽ (predators) നിന്ന് രക്ഷ നേടുവാനും വേട്ടക്കാരന് ഇരയെ കണ്ടെത്തുവാനും സഹായകമായതിനാൽ കാഴ്ചശക്തി അ

സം കൊണ്ടും രൂപവ്യത്യാസം കൊണ്ടും വളരെ അകലെ നിന്ന് കണ്ടെത്താൻ വേണ്ടി മികച്ച കണ്ണുകൾ നമുക്ക് വന്നുചേരുവാൻ സഹായകമായിഎന്ന് ചില പഠനങ്ങൾ പറയുന്നു.

മൂങ്ങകളും പൂച്ചകളും പോലെയുള്ള മൃഗങ്ങൾ, രാത്രികാലങ്ങളിലെ മങ്ങിയ പ്രകാശത്തിലെ കാഴ്ചക്കു വേണ്ടി റെറ്റിനയിൽ വലിയ കൃഷ്ണമണികളും കൂടുതൽ റോഡ് കോശങ്ങളും വികസിപ്പിച്ചെടുത്തിട്ടുണ്ട്. ചില പക്ഷികളിൽ (ഉദാ: മൂങ്ങ) റോഡ് കോശങ്ങൾ ധാരാളം കാണപ്പെടുന്നു (മനുഷ്യനേക്കാൾ അഞ്ചിരട്ടി). നമ്മളുടെ കണ്ണുകളുമായി താരതമ്യം ചെയ്യുകയാണെങ്കിൽ, അവയുടെ ശരീരഘടനയേക്കാൾ വലിയ കണ്ണുകൾ ആണ് മൂങ്ങകൾക്കുള്ളത്. അങ്ങനെ, വലിയ കണ്ണുകളും ഒട്ടനവധി റോഡ് കോശങ്ങളും (rod cells), ജന്തുലോകത്തിലെ ഏറ്റവും മികച്ച രാത്രി കാഴ്ച ലഭിക്കാൻ മൂങ്ങകളെ പര്യാപ്തരാക്കി. രാത്രിസഞ്ചാരിയായ മൂങ്ങകളെ ഈ കണ്ണുകൾ അവയുടെ അതിജീവനത്തിനു സഹായിക്കുന്നു. ആഴക്കടലിൽ ജീവിക്കുന്ന സ്രാവിന്റെ (shark) കണ്ണിനുളളിൽ റോഡ് കോശങ്ങൾ ഇടതൂർന്ന് കാണപ്പെടുന്നു, ഇത് കുറഞ്ഞ വെളിച്ചമുള്ള അവരുടെ ആവാസ വ്യവസ്ഥയിൽ നന്നായി കാണാൻ അനുവദിക്കുന്നു. കൂടാതെ, അവരുടെ കണ്ണുകളിൽ ചില കശേരുകികളിൽ കാണുന്നത് പോലെ ടപീറ്റം ലൂസിഡം കാണുന്നു, ഇത് പ്രകാശത്തെ റെറ്റിനയിലേക്ക് പ്രതിഫലിപ്പിക്കുകയും ലഭ്യമായ പ്രകാശത്തിന്റെ അളവ് വർധിപ്പിക്കുകയും ചെയ്യുന്നു. സസ്തിനികൾ ആയ ഡോൾഫിനുകളും തിമിംഗലങ്ങളും വെള്ളത്തിനടിയിൽ കാഴ്ചയ്ക്കു പ്രത്യേക ലെൻസുകളും കോർണിയകളും വികസിപ്പിച്ചെടുത്തിട്ടുണ്ട്.

പരിണാമംമൂലം ചില മൃഗങ്ങൾക്ക് കണ്ണുകൾ നഷ്ടപ്പെട്ടതായി നമുക്ക് കാണാം. (ഉദാ: Astyanax mexicanus എന്ന മെക്സിക്കൻ അന്ധ ഗുഹ മത്സ്യത്തിനു കണ്ണുകൾ ഇല്ല). ഗുഹകളിൽ ഭക്ഷണം വളരെ കുറവായതിനാൽ, അന്ധമത്സ്യങ്ങൾക്ക് അവയുടെ ഊർജം സംരക്ഷിക്കേണ്ടതുണ്ടെന്നും കാഴ്ചയില്ലാത്ത അവസ്ഥ അവർക്ക് അതിജീവനം നൽകുന്നുവെന്നും പഠനങ്ങൾ പറയുന്നു.

കമേലിയൻ (chameleon) ഉരഗവർഗത്തിൽ പെട്ട വർണ്ണാഭമായ പല്ലികളാണ്. അവ നിറം മാറ്റാനുള്ള കഴിവിന് പേരുകേട്ടതാണ്. കമേലിയന് ലെൻസുകളുടെ ആകൃതി മാറ്റാനും വ്യത്യസ്ത അകലത്തിലുള്ള വസ്തുക്കളിൽ ശ്രദ്ധ കേന്ദ്രീകരിക്കാൻ കണ്ണുകളുടെ സ്ഥാനം ക്രമീകരിക്കാനും കഴിയും. ഏറ്റവും വിശാലമായ കാഴ്ചയാണ് ഇവയ്ക്കുള്ളത്. ഓരോ കണ്ണും പരസ്പരം സ്വതന്ത്രമായി തിരിക്കാനുള്ള കഴിവ് അവയ്ക്ക് ഉണ്ട്, അതിന്റെ തല ചലിപ്പിക്കാതെതന്നെ എല്ലാ കോണിലും കാണാൻ അനുവദിക്കുന്നു. ഇതിന് 90° ലംബമായും 180° തിരശ്ചീനമായും, ഏതാണ്ട് 360° കാണാൻ കഴിയും. കണ്ണുകളല്ലാതെ മറ്റൊന്നും ചലിപ്പിക്കാതെതന്നെ, ചുറ്റുപാടിന്റെ മിക്കവാറും എല്ലാ കോണുകളും കാണാനുള്ള കഴിവ് ഇരയെ ഭയപ്പെടുത്താതെ വേട്ടയാടാൻ കമേലിയനെ അനുവദിക്കുന്നു.

കഴുകൻ, പരുന്ത് തുടങ്ങിയ ഇരപിടിയൻ പക്ഷികൾക്ക് വളരെ ദൂരെ നിന്ന് ഇരയെ കണ്ടെത്താൻ കഴിയുന്ന വികസിത ദൃശ്യസംവിധാനങ്ങളുണ്ട്. മൃഗങ്ങളിൽ ഏറ്റവും മികച്ച കാഴ്ചശക്തി പരുന്തിനാണ്. മനുഷ്യനേക്കാൾ നാല് മടങ്ങ് ശക്തമാണ് അവയുടെ കാഴ്ചശക്തി. പരുന്തുകൾക്ക് മൂന്ന് മൈൽ അകലെനിന്നുപോലും ചെറിയ ഇരയെ കാണാനും ശ്രദ്ധ കേന്ദ്രീകരിക്കാനും കഴിയും.

380 മുതൽ 700 nm വരെ തരംഗദൈർഘ്യപരിധിയിലുള്ള പ്രകാശരശ്മികൾ മാത്രമേ മനുഷ്യനു കാണാൻ കഴിയുകയൂ. എന്നാൽ, പൂച്ചയെപ്പോലുള്ള ജന്തുക്കൾക്കും പക്ഷികൾക്കും മത്സ്യങ്ങൾക്കും ചില ഉരഗങ്ങൾക്കും തേനീച്ചകളും ചിത്രശലഭങ്ങളും പോലുള്ള ചില പ്രാണികൾക്കും അൾട്രാവയലറ്റ് പരിധിയിലുള്ള കാഴ്ചകളും കാണുവാൻ സാധിക്കും. ഇത് ഇവകളുടെ അതിജീവനത്തിനു വളരെ പ്രധാനവുമാണ്. 16-ലധികം വ്യത്യസ്ത ഫോട്ടോറിസെപ്റ്റർ കോശങ്ങൾ മാന്റിസ് കൊഞ്ച് എന്ന കടൽക്കൊഞ്ചിൽ കണ്ടെത്തിയിട്ടുണ്ട്. മനുഷ്യർക്ക് വർണ്ണത്തിന്റെ മൂന്ന് ചാനൽ പ്രോസസ്സ് ചെയ്യാൻ കഴിയുമ്പോൾ, മാന്റിസ് കൊഞ്ചുകൾക്കു വർണ്ണത്തിന്റെ പന്ത്രണ്ടു ചാനൽ വരെ പ്രോസസ്സ് ചെയ്യാൻ കഴിയുന്ന ഫോട്ടോറിസെപ്റ്ററുകൾ ഉണ്ട്. മാത്രമല്ല, അവയ്ക്കു വെള്ളത്തിനടിയിൽ മികച്ച കാഴ്ച നൽകുന്ന, ധ്രുവീകരിക്കപ്പെട്ട പ്രകാശ കാഴ്ചയും അൾട്രാ ലൈറ്റ് പ്രകാശകാഴ്ചയുമുണ്ട്. ഒട്ടുമിക്ക പക്ഷികൾക്കും ഉരഗങ്ങൾക്കും പ്രാണികൾക്കും നാല് വ്യത്യസ്ത കോൺ കോശങ്ങൾ ഉണ്ടെങ്കിലും മനുഷ്യർക്ക് മൂന്നുതരം കോൺ കോശങ്ങൾ ആണുള്ളത്. ചിത്രശലഭങ്ങൾക്ക് 15 തരം വ്യത്യസ്ത കോൺ കോശങ്ങൾ ഉള്ളതുമൂലം മനുഷ്യരേക്കാൾ കൂടുതൽ വ്യത്യസ്ത വർണ്ണങ്ങൾ തിരിച്ചറിയാൻ പറ്റും. വ്യത്യസ്ത മൃഗങ്ങളിലെ ഫോട്ടോറിസെപ്റ്റർ സെല്ലുകളുടെ എണ്ണത്തിലും തരത്തിലുമുള്ള വ്യത്യാസം പരിണാമത്തിനൊപ്പം അവയ്ക്കു വന്നുചേർന്നതാകാം. ഇത് അവരുടെ കാഴ്ചയിൽ കാതലായ വ്യത്യാസം വരുത്തുന്നു എന്ന് നമുക്ക് മനസ്സിലാക്കാം.

കണ്ണുകളുടെ പരിണാമ പരിശോധിച്ചാൽ വ്യത്യസ്ത ജീവികൾ അവയുടെ പ്രത്യേക ആവശ്യങ്ങൾക്കും ചുറ്റുപാടുകൾക്കും അനുസൃതമായി വ്യത്യസ്ത രീതികളിൽ കാഴ്ചശക്തിയെ രൂപപ്പെടുത്തിയെടുത്തു എന്ന് കാണാം. ചുറ്റുപാടുകളുമായുള്ള പൊരുത്തപ്പെടുത്തലുകൾ കണ്ണുകളുടെ പരിണാമത്തിലേക്കും പിന്നീട് അവരവരുടെ ആവാസവ്യവസ്ഥകളിൽ ജീവിക്കാനും വേട്ടയാടാനും അതിജീവനത്തിനും പ്രാപ്തരാക്കി. കാലക്രമേണ ജീവികൾ അവയുടെ ചുറ്റുപാടുകളുമായി എങ്ങനെ പൊരുത്തപ്പെട്ടു എന്നതിന്റെ ശ്രദ്ധേയമായ ഉദാഹരണമാണ്, കണ്ണുകളുടെ പരിണാമചരിത്രം. കണ്ണുകളുടെ പരിണാമകഥ പ്രകൃതിനിർദ്ധാരണ പ്രക്രിയയേയും ഭൂമിയിലെ ജീവന്റെ വൈവിധ്യത്തെയും കുറിച്ചുള്ള ഉൾക്കാഴ്ചകൾ സമ്മാനിക്കുന്നു.

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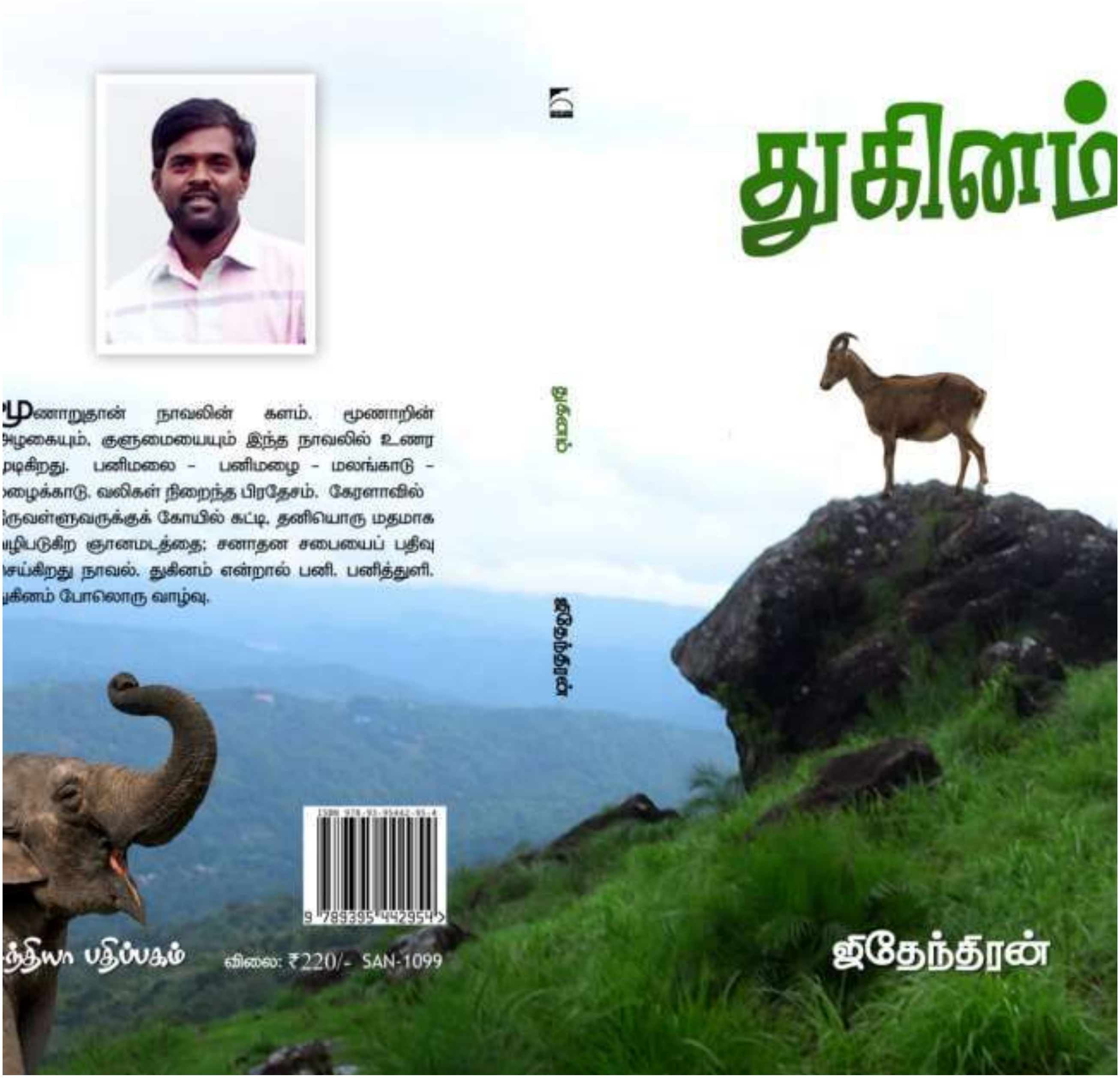
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RECENT COMPUTATIONAL TRENDS IN HUMAN BRAIN SIGNAL ANALYSIS OF ELECTROENCEPHALOGRAPHIC DATA

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Abstract - Human brain is one of the most wondrous organs that distinguish us from all other organisms. The ability to feel, adapt, reason, remember, make decision and communicate makes human beings intelligent. Human brain is capable of processing billions of bits of information per second with the help of approximately hundred billion neural connections. The latest trend in unlocking the mysteries of the mind is with the recent advancement in brain-computer interface (BCI) systems. Scientists are emphasizing their research on whether BCI can be augmented with human computer interaction (HCI) to give a new aspiration for restoring independence to neurologically disabled individuals. There are invasive and noninvasive methods for brain signal acquisition such as electroencephalography (EEG), functional MRI (fMRI), electrocorticography (ECoG), calcium imaging, magneto encephalography (MEG), functional near-infrared spectroscopy (fNIRS) and so on. Electroencephalography signals, which are small amounts of electromagnetic waves produced by the neurons in the brain are one of the most popularly used signal acquisition techniques in the existing BCI systems due to their non-invasiveness, easy to use, reasonable temporal resolution and cost effectiveness compared to other brain signal acquisition methods. Electroencephalography is essential for the diagnosis of epilepsy and useful in characterizing various neurological diseases such as Parkinson's disease, Alzheimer's disease etc. and also helps in monitoring sleep related disorders. This paper discusses the EEG data processing mechanisms using machine learning techniques and reviews the achievements in this field.

Keywords - Brain-Computer-Interface, Brain Signal, Deep Learning, EEG, Human-Computer-Interaction

I. INTRODUCTION

Nearly one billion people in this world are struggling with several neuromuscular disorders. Human brain research studies can be very beneficial which enables to record and analyse brain signal patterns and convert into useful commands. The brain computer interface systems ensemble the gap between humans and intelligent electronic devices. The brain signals provide possible means to human –computer interaction by training the computer to recognize and classify EEG signals thereby accomplishing what they really want to do. The roots of brain –computer interaction starts with Hans Berger's discovery of the electrical activity of the human brain and the invention of electroencephalography in 1924 [1]. Berger was the first to record human brain signals with the help of EEG. Even though there exist several invasive and non-invasive brain signal acquisition techniques; EEG become the most popularly used signal acquisition technique due to its cost effectiveness, reasonable temporal resolution, less frequency, portability and ease of use. Non-invasive techniques include fMRI, fNIRS, MEG etc. Functional near infrared spectroscopy (fNIRS) measures the brain activity using near infrared spectroscopy for functional neuroimaging [2]. The functional magnetic resonance imaging (fMRI) maps the neural activity by imaging the hemodynamic responses which relies on the blood flow. The primary form of fMRI uses blood-oxygen-level dependent (BOLD). Magnetoencephalography (MEG) is the measurement of magnetic field generated by the electrical activity of neurons [3]. Though MEG may detect more restricted groups of sources than EEG [4], high cost and non-portability reduces its use. Electrocorticography (ECoG) is an invasive method in which electrical activities of the brain are recorded from cerebral cortex. ECoG has been used to localize epileptic zones during pre-surgical planning by placing the electrodes directly on the surface of the brain [5]. This degrades the scope of the method. The summary of the brain acquisition methods is tabulated in table 1

Method	Acquisition technique	Measured activity	Portability	Advantage	Disadvantage
EEG	Non-invasive	Electrical	Portable	Easy, safe, less cost	Non stationary
MEG	Non-invasive	Magnetic	Non-portable	Have wider range of frequency	Expensive
fMRI	Non-invasive	Metabolic	Non-portable	high temporal and spatial resolution	Slow data acquisition
NIRS	Non-invasive	Metabolic	Portable	High spatial resolution	Less temporal resolution
ECoG	Invasive	Electrical	Portable	High spatial resolution	Sampling time is limited
Intracortical neural recording	Invasive	Electrical	Portable	High spatial resolution	Medical issues

Table 1. Brain signal acquisition techniques and their features.

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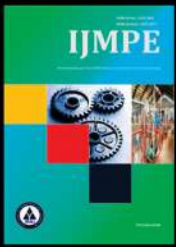

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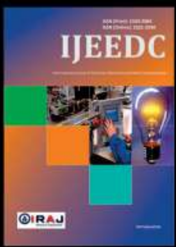

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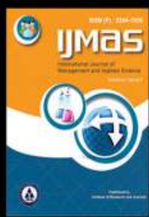

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Robust Sizing of Mangosteen Fruits with YOLOv5-enhanced Image Analysis

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Abstract. Accurate determination of fruit size plays a pivotal role in agricultural research, as it directly impacts quality assessment and the ability to predict yields. This research offers a comprehensive and dependable solution for fruit size estimation in agricultural research, thereby facilitating enhancements in yield prediction, quality control, and overall fruit production management. In this work, an innovative method is introduced for detecting and estimating the size of mangosteen fruits using the YOLOv5 deep learning model and characterization of macro-camera images. The YOLOv5, a cutting-edge deep learning algorithm, is employed to automatically detect and precisely locate mangosteen fruits within images captured by the macro camera. YOLO's remarkable accuracy and real-time processing capabilities streamline the fruit detection process, reducing the need for manual intervention and significantly enhancing data collection efficiency. Monthly field trials were conducted from March to September to capture the images of mangosteen for measuring the fruit sizes, which were found to vary between 1cm and 6.1cm. The application of YOLOv5 for fruit detection yielded an outstanding training accuracy of 99.5% by the 20th epoch. The results of the study underscore the substantial improvement achieved in terms of efficiency and accuracy when compared to traditional fruit sizing methods. The fruit size estimated using the bounding box parameters is verified using the magnification formula of the lens. This methodology of validating the accuracy and reliability of fruit size estimation technique yielded a negligible relative error of 3%.

Keywords: Mangosteen, YOLOv5, Macro Camera, Image Sensor, Magnification lens formula

1. Introduction

Tropical fruits like mangosteen (Garcinia mangostana Linn. - GML) are coveted for their salivating flavour and possible beneficial effects on health. Due to the abundance of nutrients as well as its delicious aroma, demand for it is rising on an international scale. This tropical tree is native to Thailand, Sri Lanka, Malaysia, Myanmar, India, and the Philippines. This species of tree grows slowly, to a height of 6 to 25 meters, and its leaves are brittle and glabrous. The consumable pulp of the dark purple or reddish mangosteen fruit is white, soft, and juicy, with a mildly acidic and sweet flavour and an intriguing aroma. Due to its exceptional flavour among tropical fruits, mangosteen is referred to as "the queen of fruits" [1]. The average diameter of a mangosteen fruit is five to seven centimeters, making it approximately equivalent to the dimensions of a tangerine. Hidayat, D. D. et al. state that the mangosteen fruit's geometrical mean diameter is 54.79 ± 9.15 mm [2]. Mangosteen fruit size measurement accuracy is essential for a number of processes, including distribution, grading, yield, quality control, and packaging. The fruit size and quantity are currently determined by the processing centers only after harvesting, weighing, and sorting of fruits using industrial grading equipment. However, these manual methods are laborious and prone to human errors.

Deep learning methodologies signify a notable progression in this specific field of research. Several investigations have concentrated on the assessment of the quantity and dimensions of fruits based on image analysis [3, 4]. Utilizing deep learning algorithms like YOLOv5 can streamline and enhance fruit detection procedures, thereby enabling precise size calculations. YOLOv5 enables accurate measurements of fruit sizes while they are still on trees. This data assists farmers in making informed decisions about irrigation, fertilization, and crop management practices tailored to different fruit sizes and stages of growth. With precise size estimation, farmers can optimize and schedule harvesting more efficiently [5, 6]. This allows them to prioritize areas with fruits reaching the desired size, reducing the chances of underripe or overripe fruits being picked.

Using advanced image analysis techniques and the YOLOv5 deep learning object detection algorithm, this study aims to contribute a robust and feasible model to the challenges of mangosteen fruit sizing, offering improved accuracy and scalability for enhanced agricultural practices. YOLOv5 was designed specifically for better detection

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of small objects [7]. Leveraging this specific capability of YOLOv5, a pretrained model is proposed for training the mangosteen dataset. The primary objective of this work is to detect on tree fruits and determine their sizes, which is then validated through the application of lens magnification formula. Overall, on tree fruit size estimation using YOLOv5 has a broad impact on agricultural practices, improving precision, efficiency, and the quality of produce while also aiding in strategic decision-making for farmers in managing their crops and market supply.

2. Related Works

Literature shows that the application of machine learning (ML) and deep learning (DL) models has been revolutionary in the field of precision agriculture. The precision agriculture review paper discussed crop identification and pest/disease detection using ML and DL techniques [8]. Qureshi, W. S. et al. estimated the fruit count in the images of mango trees using support vector machine classification and K-nearest neighbour pixel classification [9]. Wang, Z. et al. evaluated the fruit size of mango trees using RGB-D images, which facilitates the estimation of fruit maturation and size distribution with an RMSE of 4.9 mm. Finding the fruit size in the work requires knowing the distance between the object and the camera, which can be obtained using RGB-D camera technology [10]. The mango fruit was identified by Behera, S. K. et al. with 98% accuracy using the Randomizes Hough Transform (RHT) technique, and the size was measured with an average error of 3.07%. In the work, the fruit's colour was also identified [11]. Gongal, A. et al. took pictures of apple tree canopies using a time-of-flight (TOF) light-based 3D camera and a colour CCD camera in order to identify apples and measure their sizes. The accuracy of the authors' pixel size method, which they introduced, increased to 84.8% when estimating the size of an apple surface [12]. Apolo-Apolo, O. E. et al. used DL techniques to calculate citrus fruits' size using a UAV with standard error of 7.22% [6]. In the work of Mirbod, O. et al., apple fruits in an orchard were identified using Faster R-CNN, segmented using Mask R-CNN, and their size was estimated using images from stereo vision cameras. The estimated diameter of the apple fruit was determined to be 1.08 mm, with standard deviation errors of 0.73 mm [4].

The fruit detection process can be improved and streamlined by incorporating DL algorithms such as YOLOv5, which makes size calculations accurate and efficient. DL techniques applied to computer vision have transformed a number of industries, including autonomous vehicles and medical image analysis. Using YOLO, the healthy and unhealthy plant leaves were categorized with an accuracy of 82.38% and latencies of 2-3 seconds [13]. According to Sarda, A. et al.'s work, bounding boxes can be used to categorize objects on road into appropriate groups (mAP 74.6%) [14]. In a comparative analysis of Transformer, EfficientDet, and YOLOv5 for crop detection in remote sensing imagery, Mekhalfi, M. L. et al. found that YOLOv5 could detect more objects than the other two [15]. The ball pepper plant leaf bacterial spot disease was detected by Mathew, M. P. et al. with YOLOv5 and mAP 90.7% [5]. Using YOLOv5, Egi, Y. et al. suggested a methodology that counts the number of red and green tomatoes as well as the number of flowers with an accuracy of 0.618 at mAP 0.5 by using drone footage of the greenhouse [16].

Banana leaf diseases such as Sigatoka and Leafspot, along with healthy leaves were identified and classified using ML and DL techniques, namely KNN, SVM, Alexnet, VGG19. ResNet50, DenseNet201, and MobileNetV2 [17, 18]. Ahmad, I. et al. created a model using the YOLOv5 algorithm to identify and categorize crop-damaging insect pests in order to increase production. They also suggested a smartphone based automated system with an accuracy of 98.3% [19]. Using enhanced YOLOv5 with a mAP value of 44.7%, tassel was found in RGB UAV imagery, which was much better than other well-known methods [20]. Using improved YOLOv5 model training, Dai, G. et al. suggested a model to identify and grade the sprouted potatoes with accuracy 90.14% and mAP 88.1% [21]. An enhanced model for identifying plant diseases by Chen, Z. et al., which was derived from the YOLOv5 DL model, was utilized to detect the pests under the intricate natural circumstances. This enhanced YOLOv5 performed 5.4% better than the original YOLOv5 [22]. In Karakaya, M. et al.'s work, the YOLOv5 DL model provided more accurate results than the other YOLO models, with 92.96% precision in the recognition and classification of five distinct diseases in tomato leaves [3]. An enhanced YOLOv5 was proposed by Huang, T. et al. to detect small objects in mAP@0.5 with 95% accuracy [23]. The lotus seed pods were detected by Ma, J. et al. using an improved YOLOv5 model, which resulted in a 0.7% higher accuracy compared to the classical YOLOv5s model [24].

Sa, I. et al. introduced an innovative model for fruit detection using DL neural networks. Their proposed multi-modal Faster R-CNN achieved state-of-the-art performance, particularly excelling in the detection of sweet peppers. The model improved precision and recall capabilities, as evidenced by the enhanced F1 score, which increased from 0.807 to 0.838 compared to previous methods [25]. Horea, M. et al. developed a DL software proficient in recognizing fruits from images with an accuracy of 96.3% [26]. Nguen, H. H. C. et al. explored the DL algorithms and led to the acquisition of DL knowledge, culminating in the development of a model proficient in recognizing fruits from images [27]. Koirala, A. et al. demonstrated the superior performance of DL models in on plant fruit

PEOPLE AND ENVIRONMENT
Concerns and Challenges

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EPIDEMICS AND ENVIRONMENT

Dr C. R. Dhanya

Introduction

An epidemic is the episode of cases of an illness, specified health behavior, or other health-related events in excess of normal expectancy in a community or region. The area covered by an epidemic may be restricted to a small area such as a school classroom, or it may extend to comprise many countries. Epidemics may also last from a few hours to many years (Manfred S. Green 2002).

HUMAN AND EARTH ENVIRONMENT

There is a long term equilibrium established between human and earth environment. Altering physical environment and adapted human behaviors are perturbing this equilibrium. Greek physician Hippocrates, known as the father of medicine is the first person known to have stated the association between incidence of diseases and environmental influences (Ray M. Merrill 2010).When a disturbance occurs in the equilibrium amid disease causing agent, host and the environment, it destines in anillness. When environmental condition favors disease causing agent and disfavor human, the disease turns out to be an epidemic. The most important environmental factors that influence the spread of communicable diseases that are prone to cause epidemics include water supply, sanitation facilities and climate. There are numerous water borne and airborne diseases that are influenced by environmental factors and those that are repercussions of environmental disasters.

EPIDEMICS – THE GLOBAL SCENARIO

According to the World Health Organization (WHO), around 3 to 5 million people are affected worldwide by cholera and results in more than 100,000 cases of mortality. Cholera is one of the most prevalent water-related infections in many regions of the world, specifically in South Asia, sub-Saharan Africa, and Latin America. Studies point out that vast majority of cholera outbreaks originate in coastal regions, indicating a strong association between environment and the disease (Akanda AS 2009, Jutla AS 2011).Primary source of water in households are generally rivers. Warm air temperature, increased water temperature and water evaporation, and decreased water levels in riversare linked to cholera outbreaks. Decreased water level results in increased salinity (Peterson D 1996) which creates favorable environmental conditions for growth of cholera bacteria (Huq A 2005, Islam MS 2004)and, together with increased rainfall and poor sanitation, yields a higher chance of a cholera epidemic (Antarpreet Jutla 2013).The Haitian cholera outbreak following massive earthquake in 2010 was human driven. However, studies indicate that hydro-climatological processes also play an important role. It was pointed out that the

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Natural Product Based Drug Discovery Against Human Parasites

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Antimicrobial Peptides (AMPs): Current State and Future Prospects for the Treatment of Human Parasitic Diseases

11

Maya Madhavan, P. K. Sumodan, C. R. Dhanya, Aarcha Shanmugha Mary, and Sabeena Mustafa

Abstract

Antimicrobial peptides (AMPs) are natural compounds that are primarily used in the development of new therapeutic components for a variety of illnesses, such as infectious diseases, parasitic illnesses, cancer, etc. Due to the rising occurrence of drug resistance, AMPs are used the same as antibiotics. Since the discovery of the first AMP, numerous studies have been conducted to determine the importance of amino acid residues showing antimicrobial activity and to develop and characterize potential AMPs. Since wet-lab experimental identification requires a lot of effort and cost, in silico studies are widely used to identify novel AMP candidates. In silico studies aid in the identification and modeling of AMPs. However, wet-lab studies using assays are assisting in characterizing the newly identified AMPs and their therapeutic potential. Thus, a number of researches helped to uncover the diversity of AMPs as well as the different classes within them. In this book chapter, we cover a wide range of AMP classifications, the

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mechanism of action of AMPs, various AMP-based drugs identified so far for treating parasitic diseases. Also, we illustrate how the approach of AMPs has helped in finding out remedies for Malaria. Additionally, we explain computational methods and resources for better research in the field of AMPs studies.

Keywords

Antimicrobial peptides (AMPs) · AMP classification · peptide modelling · defensin · malaria · parasites

11.1 Classification of Antimicrobial Peptides (AMPs)

Antimicrobial peptides (AMPs) are a class of components with significant innate immune properties. These are small natural compounds found in many microbiological organisms, including bacteria, fungus, and viruses, as the name implies. Insects, being a highly biodiverse group are abundant and most inventive sources of AMPs due to their biodiversity. AMPs have so many features in common such as; having a length of around 10–50 amino acids, a high proportion of hydrophobic amino acids, cationic nature and their immune modulatory abilities. However, a lot of dissimilarities exist between them which enable the classification of AMPs. One method of classifying AMPs is depending on whether synthesized by ribosomes or not. Accordingly, there are two classes—ribosomally synthesized and non-ribosomally synthesized AMPs. Non-ribosomal AMPs, such as vancomycin, are not synthesized using the protein translation machinery, instead, they are made using non-ribosomal peptidyl synthetases. A number of important classes of AMPs is discussed below.

11.1.1 Based on the Source

AMPs can be broadly classified into bacterial, plant and animal AMPs based on their biological source. Bacteriophages are found to serve as a source of AMPs, leading to two classes- phage-encoded lytic factors and phage tail complexes. Bacteria produce both ribosomal and non-ribosomal AMPs. Bacteriocins, the ribosomal AMPs generated from gram-positive bacteria, can be classified into lantibiotics, non-lantibiotics, large-sized bacteriocins and uniquely structured bacteriocins. The AMPs found in gram-negative bacteria can also be classified further into colicins, colicin-like, microcins and phage tail-like bacteriocins. Plants host a range of AMPs that are rich in cysteine and disulphide bridges, which provide protection against proteolytic degradation.

The animal AMPs can still be classified into insect, amphibian and mammalian AMPs. Insect-derived AMPs help the insects to adapt to their survival. E.g. Cecropin A. Among amphibians, the main sources of AMPs are frogs, the most important AMP being magainin. Mammalian AMPs, of which a large proportion is formed by

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Multidisciplinary Perspectives

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K.M. Sajad Ibrahim

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SCREENING OF PHYTOCHEMICAL, ANTIOXIDANT AND ANTIBACTERIAL ACTIVITY OF *MIMOSA PIGRA* L. LEAF EXTRACTS

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Introduction

Nature has served as a rich repository of medicinal plants for thousands of years and an impressive number of modern drugs have been isolated from natural sources, notably of plant origin [1]. Herbal medicine, based on their traditional uses in the form of powders, liquids or mixtures, has been the basis of treatment for various ailments in India since ancient times. The use of herbs as complementary and alternative medicine has increased dramatically in the last 20–25 years [2]. According to World Health Organization traditional medicines are relied upon by 65–80% of the World's population for their primary health care needs. Moreover, emergence of multiple drug resistant strains of microorganisms due to indiscriminate use of antibiotics to treat infectious diseases has generated a renewed interest in herbal medicine [3]. Mimosa pigra, commonly known as the giant sensitive tree, is a species of the genus Mimosa, in the family Fabaceae. It is native to the Neotropics, but has been listed as one of the world's 100 worst invasive species and forms dense, thorny, impenetrable thickets, particularly in wet areas. Mimosa pigra is a woody invasive shrub that originates from tropical America and has now become widespread throughout the tropics [4]. Very few traditional uses have been identified, mostly the plant is treated as an invasive weed. Among the few uses listed include the following. The plant is used in tropical Africa as a tonic and as a treatment for diarrhea, gonorrhea, and blood poisoning. The leaf is said to contain Mimosine; it is purgative and functions as a tonic. A decoction of the leaves and stems is used to treat thrush in babies and bed-wetting in children. The powdered leaf is taken with water to relieve swelling and inflammation. The leaves are macerated and put on the eyes to remove irritation [5]. The roots are reported to be aphrodisiac in nature. The root ash is sprinkled over leprous patches on the skin to treat leprosy. The seed is emetic and expectorant in nature. They are also used to treat tooth problems [6]. This study was aimed to carry out the phytochemical screening of the different extracts of *Mimosa pigra* L.,

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quantification of flavonoid and total phenolic content, determination of antioxidant potential and antibacterial effect.

Materials and Methods

Collection of plant and preparation of leaf extracts

The leaves of *Mimosa pigra* L. were procured locally. The leaves were cleaned, shade dried and were powdered using a blender. A known weight (10g) of the powdered material was soaked in 150ml of various solvents such as hexane, chloroform and methanol for a period of 3 weeks at room temperature with occasional stirring. The extract was filtered using a cheese cloth and the dried by subjecting to evaporation at room temperature.

Phytochemical screening

Each extract was dissolved in water at a concentration of 2mg/ml and were screened for the following phytochemicals as per standard protocols [7].

Alkaloids (Wagner's Test)-A fraction of the extract when treated with 3-5 drops of Wagner's reagent shows reddish brown colour or precipitate indicating the presence of alkaloids.

Carbohydrates (Molisch's test)-To about 2ml of the extract a few drops of Molisch's reagent is added followed by drops of conc. H_2SO_4 along the sides of the test tube. Formation of a reddish-violet ring at the interphase indicates the presence of carbohydrate.

Cardiac glycosides (Keller Kelliani's Test)- To about 5ml of the extract 2ml of glacial acetic acid was added followed by 1ml of conc. H_2SO_4. A brown ring at the interphase indicates the presence of cardiac glycosides.

Flavonoids (Alkaline reagent Test) -2ml of the extract treated with a few drops of 20% NaOH results in the formation of a deep yellow colour, which turns colorless on addition of dilute HCl indicating the presence of flavonoids.

Phenols (Ferric chloride Test) - A fraction of the extract when treated with aqueous 5% ferric chloride gives a deep blue/black colour, indicating the presence of phenols.

Phlobatannins (Precipitate Test) - 2ml of extract is boiled with 1ml of 1% aqueous HCl. Formation of a red precipitate indicates the presence of Phlobatannins.

Amino acids and proteins (Ninhydrin Test/Biuret Test) -Formation of purple colored complex when the 2ml of the extract is boiled with 2-5 drops of Ninhydrin reagent indicates the presence of amino acids. Formation of a violet colour with Biuret reagent will indicate the presence of proteins.

Saponins (Foam test) -2ml of extract is added to 6ml of water and shaken vigorously. Formation of persistent foam indicates the presence of saponins.

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BIOLOGICAL PROPERTIES OF SYNTHETIC AMINO BENZO QUINONES

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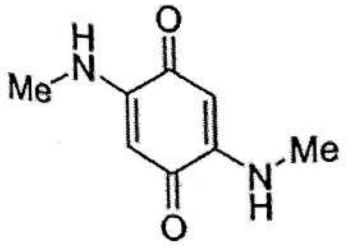
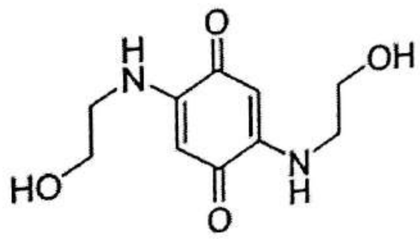
Introduction

Quinones constitute a structurally diverse class of phenolic compounds with a wide range of pharmacological properties, which are the basis for different applications in the broad field of pharmacy and medicine. Many of the drugs clinically approved or still in clinical trials against cancer are quinone related compounds. Some of these pharmacological effects have been attributed to the formation of DNA-damaging anion-radical intermediates formed by bio reduction of the quinone nucleus. Quinone-based fungicides are classified as "organic fungicides" and are known multisite inhibitors. Amino benzoquinones (ABQs) are a class of important quinone compounds featuring diverse biological properties, with very wide applications in medicinal, pharmaceutical and dye industry. They are mainly the colour giving agents in many pigments found in mushrooms. Amino benzoquinones deserves great prominence owing to their broad-spectrum biological activity as reported by various workers. Their antimicrobial and anticancer activities have been studied by several scientific teams.

This article describes the biological properties of two synthetic amino benzoquinone derivatives: ABQ1-2,5-bis (methyl amino)-1,4-benzoquinone and ABQ2-2,5-bis (ethanolamino)-1,4-benzoquinone.



2,5-bis(methyl amino)-1,4-benzoquinone



2,5-bis(ethanolamino)-1,4-benzoquinone

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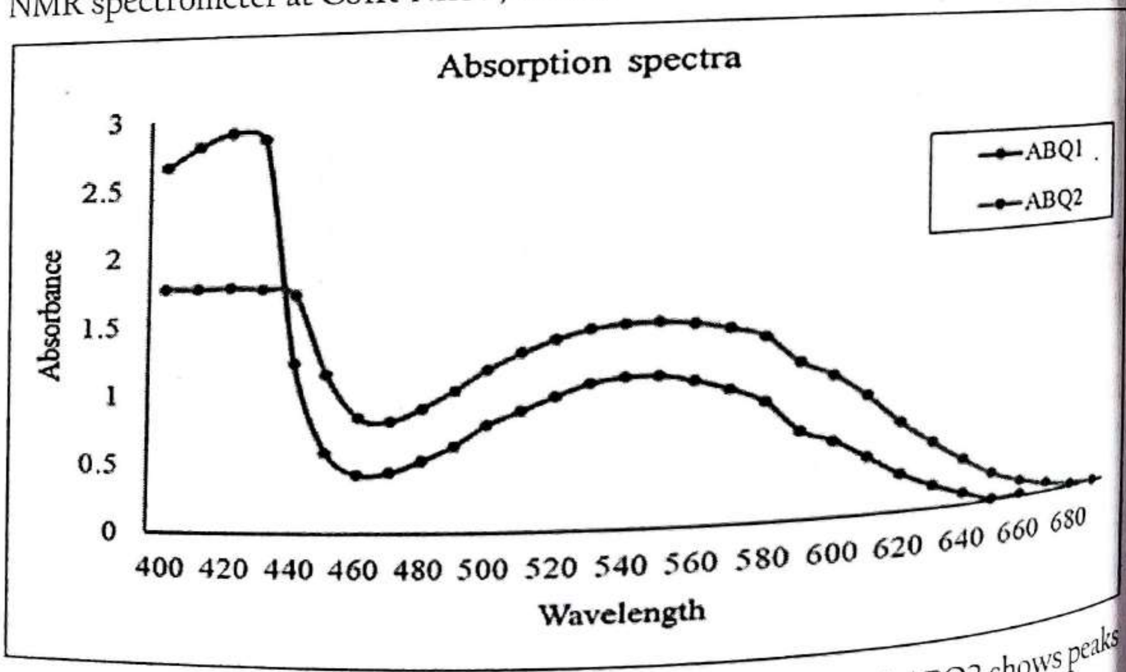
Preparation of samples: ABQ1 was synthesized by adding methylamine (0.62g, 20 mmol) to 3-ethoxy-4-hydroxy benzaldehyde (1.66g, 10 mmol) in 20 mL methanol under optimized reaction conditions. Work up and purification afforded bright red crystals. Elemental analysis confirmed the formula of the compound as $C_8H_{11}N_2O_2$.C, found (calc) −57.80% (57.82%), H, found (calc) - 6.09% (6.07%), N, found (calc) - 16.80% (16.86%). HR-ESI-MS *m/z* calculated for $C_8H_9N_2O_2$ $[M+H]^+$167.0821 found 167.0821. ABQ2 was synthesized by the addition of ethanolamine (0.12g, 20 mmol) to 3-ethoxy-4-hydroxy benzaldehyde (1.66g, 10 mmol) in 20 mL methanol under optimized reaction conditions. Work up and purification afforded bright red crystals. Elemental analysis confirmed the formula of the compound as $C_{10}H_{14}N_2O_4$.C, found (calc) −53.10% (53.09%), H, found (calc) - 6.25% (6.24%), N, found (calc) – 12.36% (12.38%).^{1}H NMR spectrum gives HR-ESI-MS *m/z* calculated for $C_{10}H_{15}N_2O_4$ $[M+H]^+$227.1032,observed 227.1036. The samples were insoluble in water, thus solubilized in minimum volume of dimethyl sulfoxide (DMSO) and diluted to 200µg/ml with distilled water. All analysis were conducted using this solution. The compounds were characterized by measuring absorbance spectra and by NMR spectral analysis. NMR spectra of the ABQs were recorded in $CDCl_3$ with TMS as the internal standard in Bruker Ascend 500MHz NMR spectrometer at CSIR-NIIST, Kerala



Absorption Spectra of ABQ1 and ABQ2. Both ABQ1 and ABQ2 shows peaks at 420nm and 550nm.

The wavelength at which the compound absorbs most is known as its absorption maxima, λmax. At this wavelength maximum sensitivity will be obtained in a photometric measurement.

NMR spectra: ^{1}H NMR spectrum of ABQ 1 gives a sharp singlet at δ 5.15 ppm corresponding to the benzoquinone ring protons while the doublet at δ 2.75 ppm

Image-Based Plant Leaf Disease Detection and Classification using Deep Learning Models

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Abstract
Early detection of plant leaf diseases is beneficial as it helps agriculturists to apply remedial measures well in advance. This is highly recommended for a good yield from crops, which enhances the economy of an agriculture-based country. Computer Vision and Deep Learning techniques, used in the field of precision agriculture facilitate early detection of plant leaf diseases. Literature proclaim that deep learning models outperform the machine learning approaches for classification of leaf diseases. In this paper, the state-of-the-art deep learning methods for detection and classification are applied on banana leaf dataset. The AlexNet, VGG19, DenseNet201, ResNet50, and MobileNetV2 Convolutional Neural Networks are the models compared in this paper. The real time images of banana leaves are used to train and test these models' using python. Healthy and two common diseases of banana leaves are classified in this work. After data augmentation and preprocessing, all the models could achieve good testing accuracies of more than 90.6% in the 80-10-10 training-validation-testing set.

Keywords
Plant Disease, Image Pre-processing, Data Augmentation, Computer Vision, Deep Learning.

1. Introduction

Plants are usually affected by many diseases and proper precautions are needed for better results in the farming field. The main reason for infection of plant leaves is the seasonal change in climate and it adversely affects the crop yield. The unavailability of expert's opinion about the farming and less knowledge about diseases and fertilizer management will also affect the yield [1]. This will lead to ecological imbalance and economic insecurity of the nation. The diseases of the plants start from minor symptoms to serious damage of the whole plant. Hence, early detection of diseases is highly crucial and is the aim of disease classification [2].

Computer Vision with deep learning techniques have a great impact on precision agriculture especially in object detection and recognition [3]. The automated plant disease detection will help for an error free classification of diseases in less time. Huge number of real time images are collected and trained to give an optimal solution at minimal cost. Various machine learning and deep learning algorithms are used to detect and classify the diseases and also to provide proper guidance to the farmers for recognition [4]. In terms of scale of production and marketing, banana is the one of the important crop fruits in the world [5]. The diseases and pests in the leaves of banana affects the production landscapes and global food security of the world. Timely intervention for remedial actions is the result of early identification of a crop disease and will have less impacts on food supply chains. The proposed work uses healthy and diseased banana leaves images to train AlexNet, VGG19, ResNet50, DenseNet201 and MobileNetV2 deep learning models. The two common diseases of banana leaves considered in this paper are Leafspot and Sigatoka. The objective of this work is to apply image pre-processing techniques on RGB based banana leaves and to classify the leaves using deep learning approaches. All deep learning models of this work gave more than 90.6% accuracy and good precision, recall and f1-score values in the 80% of training set. The AUC is 0.98, 0.99 and 1 in all models of the three classes. Selection of the appropriate model for disease detection and classification greatly depends on the accuracy [6].

2. Related Works

Many works have been done in the field of farming technology and precision agriculture because of the relevance of plant leaf disease detection and classification. For quality testing automated systems are widely used in precision agriculture [7], [8]. 14 crops' disease detection and classification were done by S. P. Mohanty et al. [9] and E. C. Too et al. [10] in their work using different deep learning techniques such as AlexNet, GoogleNet, DenseNet121, Inception V4, ResNet50, ResNet101, ResNet152, and VGG16 and achieved more than 85% accuracy. Nine diseases of the tomato leaves were classified by M. Brahimi et al. [11] using AlexNet and GoogleNet with 99% accuracy. K. P. Ferentinos [12] got 99% accuracy using the AlexNet model by classifying 25 crops' classes. M. G. Selvaraj et al. [13] proposed the models with ResNet50, InceptionV2, MobileNetV1 and achieved up to 88.88% accuracy for banana leaves' disease classification. ResNet50 and AlexNet algorithms were used by H. Ajra et al. [14] to classify potato and tomato leaves in different training testing combinations. Tea leaves were classified by G. Hu et al. [15] using VGG16 and gave only 72.5% with 398 images. The accuracy greatly depends on the data size taken. Six classes of wheat leaves were classified by T. Hayit et al. [16]. VGG16 and VGG19 deep learning models gave an accurate classification system for classification of potato leaves [17] and grapes leaves [18]. The EfficientNet algorithm models are outperforms the other deep learning methods in original and augmented image datasets [19]. The SqueezeNet mobile deep learning classification by H. Durmus et al. [20] achieved better results than AlexNet due to its lightweight and low computational needs. The PlantVillage dataset was used to train the deep network models in most of the researches [21].

3. Materials and Methods

The proposed method creates five models which could classify banana leaves as Healthy, Leafspot, and Sigatoka using AlexNet, VGG19, DenseNet201, ResNet50, and MobileNetV2 deep learning algorithms. The architecture of the proposed work is depicted in the Figure 1.

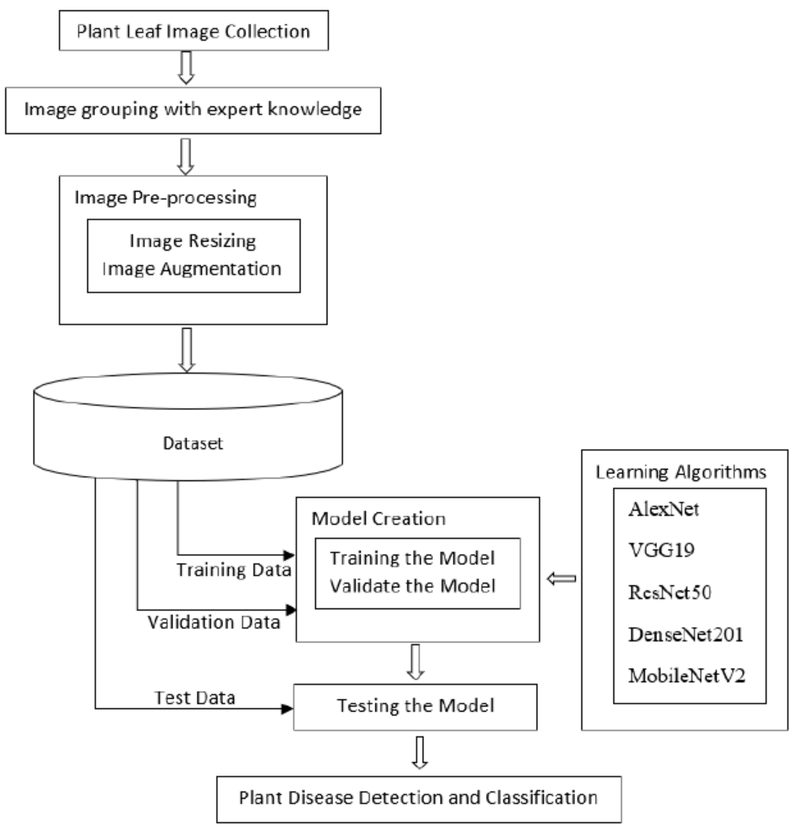

Figure 1: Architecture of Plant Leaf Classification Methodology

Robust Sizing of Mangosteen Fruits with YOLOv5-enhanced Image Analysis

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Abstract. Accurate determination of fruit size plays a pivotal role in agricultural research, as it directly impacts quality assessment and the ability to predict yields. This research offers a comprehensive and dependable solution for fruit size estimation in agricultural research, thereby facilitating enhancements in yield prediction, quality control, and overall fruit production management. In this work, an innovative method is introduced for detecting and estimating the size of mangosteen fruits using the YOLOv5 deep learning model and characterization of macro-camera images. The YOLOv5, a cutting-edge deep learning algorithm, is employed to automatically detect and precisely locate mangosteen fruits within images captured by the macro camera. YOLO's remarkable accuracy and real-time processing capabilities streamline the fruit detection process, reducing the need for manual intervention and significantly enhancing data collection efficiency. Monthly field trials were conducted from March to September to capture the images of mangosteen for measuring the fruit sizes, which were found to vary between 1cm and 6.1cm. The application of YOLOv5 for fruit detection yielded an outstanding training accuracy of 99.5% by the 20th epoch. The results of the study underscore the substantial improvement achieved in terms of efficiency and accuracy when compared to traditional fruit sizing methods. The fruit size estimated using the bounding box parameters is verified using the magnification formula of the lens. This methodology of validating the accuracy and reliability of fruit size estimation technique yielded a negligible relative error of 3%.

Keywords: Mangosteen, YOLOv5, Macro Camera, Image Sensor, Magnification lens formula

1. Introduction

Tropical fruits like mangosteen (Garcinia mangostana Linn. - GML) are coveted for their salivating flavour and possible beneficial effects on health. Due to the abundance of nutrients as well as its delicious aroma, demand for it is rising on an international scale. This tropical tree is native to Thailand, Sri Lanka, Malaysia, Myanmar, India, and the Philippines. This species of tree grows slowly, to a height of 6 to 25 meters, and its leaves are brittle and glabrous. The consumable pulp of the dark purple or reddish mangosteen fruit is white, soft, and juicy, with a mildly acidic and sweet flavour and an intriguing aroma. Due to its exceptional flavour among tropical fruits, mangosteen is referred to as "the queen of fruits" [1]. The average diameter of a mangosteen fruit is five to seven centimeters, making it approximately equivalent to the dimensions of a tangerine. Hidayat, D. D. et al. state that the mangosteen fruit's geometrical mean diameter is 54.79 ± 9.15 mm [2]. Mangosteen fruit size measurement accuracy is essential for a number of processes, including distribution, grading, yield, quality control, and packaging. The fruit size and quantity are currently determined by the processing centers only after harvesting, weighing, and sorting of fruits using industrial grading equipment. However, these manual methods are laborious and prone to human errors.

Deep learning methodologies signify a notable progression in this specific field of research. Several investigations have concentrated on the assessment of the quantity and dimensions of fruits based on image analysis [3, 4]. Utilizing deep learning algorithms like YOLOv5 can streamline and enhance fruit detection procedures, thereby enabling precise size calculations. YOLOv5 enables accurate measurements of fruit sizes while they are still on trees. This data assists farmers in making informed decisions about irrigation, fertilization, and crop management practices tailored to different fruit sizes and stages of growth. With precise size estimation, farmers can optimize and schedule harvesting more efficiently [5, 6]. This allows them to prioritize areas with fruits reaching the desired size, reducing the chances of underripe or overripe fruits being picked.

Using advanced image analysis techniques and the YOLOv5 deep learning object detection algorithm, this study aims to contribute a robust and feasible model to the challenges of mangosteen fruit sizing, offering improved accuracy and scalability for enhanced agricultural practices. YOLOv5 was designed specifically for better detection

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of small objects [7]. Leveraging this specific capability of YOLOv5, a pretrained model is proposed for training the mangosteen dataset. The primary objective of this work is to detect on tree fruits and determine their sizes, which is then validated through the application of lens magnification formula. Overall, on tree fruit size estimation using YOLOv5 has a broad impact on agricultural practices, improving precision, efficiency, and the quality of produce while also aiding in strategic decision-making for farmers in managing their crops and market supply.

2. Related Works

Literature shows that the application of machine learning (ML) and deep learning (DL) models has been revolutionary in the field of precision agriculture. The precision agriculture review paper discussed crop identification and pest/disease detection using ML and DL techniques [8]. Qureshi, W. S. et al. estimated the fruit count in the images of mango trees using support vector machine classification and K-nearest neighbour pixel classification [9]. Wang, Z. et al. evaluated the fruit size of mango trees using RGB-D images, which facilitates the estimation of fruit maturation and size distribution with an RMSE of 4.9 mm. Finding the fruit size in the work requires knowing the distance between the object and the camera, which can be obtained using RGB-D camera technology [10]. The mango fruit was identified by Behera, S. K. et al. with 98% accuracy using the Randomizes Hough Transform (RHT) technique, and the size was measured with an average error of 3.07%. In the work, the fruit's colour was also identified [11]. Gongal, A. et al. took pictures of apple tree canopies using a time-of-flight (TOF) light-based 3D camera and a colour CCD camera in order to identify apples and measure their sizes. The accuracy of the authors' pixel size method, which they introduced, increased to 84.8% when estimating the size of an apple surface [12]. Apolo-Apolo, O. E. et al. used DL techniques to calculate citrus fruits' size using a UAV with standard error of 7.22% [6]. In the work of Mirbod, O. et al., apple fruits in an orchard were identified using Faster R-CNN, segmented using Mask R-CNN, and their size was estimated using images from stereo vision cameras. The estimated diameter of the apple fruit was determined to be 1.08 mm, with standard deviation errors of 0.73 mm [4].

The fruit detection process can be improved and streamlined by incorporating DL algorithms such as YOLOv5, which makes size calculations accurate and efficient. DL techniques applied to computer vision have transformed a number of industries, including autonomous vehicles and medical image analysis. Using YOLO, the healthy and unhealthy plant leaves were categorized with an accuracy of 82.38% and latencies of 2-3 seconds [13]. According to Sarda, A. et al.'s work, bounding boxes can be used to categorize objects on road into appropriate groups (mAP 74.6%) [14]. In a comparative analysis of Transformer, EfficientDet, and YOLOv5 for crop detection in remote sensing imagery, Mekhalfi, M. L. et al. found that YOLOv5 could detect more objects than the other two [15]. The ball pepper plant leaf bacterial spot disease was detected by Mathew, M. P. et al. with YOLOv5 and mAP 90.7% [5]. Using YOLOv5, Egi, Y. et al. suggested a methodology that counts the number of red and green tomatoes as well as the number of flowers with an accuracy of 0.618 at mAP 0.5 by using drone footage of the greenhouse [16].

Banana leaf diseases such as Sigatoka and Leafspot, along with healthy leaves were identified and classified using ML and DL techniques, namely KNN, SVM, Alexnet, VGG19. ResNet50, DenseNet201, and MobileNetV2 [17, 18]. Ahmad, I. et al. created a model using the YOLOv5 algorithm to identify and categorize crop-damaging insect pests in order to increase production. They also suggested a smartphone based automated system with an accuracy of 98.3% [19]. Using enhanced YOLOv5 with a mAP value of 44.7%, tassel was found in RGB UAV imagery, which was much better than other well-known methods [20]. Using improved YOLOv5 model training, Dai, G. et al. suggested a model to identify and grade the sprouted potatoes with accuracy 90.14% and mAP 88.1% [21]. An enhanced model for identifying plant diseases by Chen, Z. et al., which was derived from the YOLOv5 DL model, was utilized to detect the pests under the intricate natural circumstances. This enhanced YOLOv5 performed 5.4% better than the original YOLOv5 [22]. In Karakaya, M. et al.'s work, the YOLOv5 DL model provided more accurate results than the other YOLO models, with 92.96% precision in the recognition and classification of five distinct diseases in tomato leaves [3]. An enhanced YOLOv5 was proposed by Huang, T. et al. to detect small objects in mAP@0.5 with 95% accuracy [23]. The lotus seed pods were detected by Ma, J. et al. using an improved YOLOv5 model, which resulted in a 0.7% higher accuracy compared to the classical YOLOv5s model [24].

Sa, I. et al. introduced an innovative model for fruit detection using DL neural networks. Their proposed multi-modal Faster R-CNN achieved state-of-the-art performance, particularly excelling in the detection of sweet peppers. The model improved precision and recall capabilities, as evidenced by the enhanced F1 score, which increased from 0.807 to 0.838 compared to previous methods [25]. Horea, M. et al. developed a DL software proficient in recognizing fruits from images with an accuracy of 96.3% [26]. Nguen, H. H. C. et al. explored the DL algorithms and led to the acquisition of DL knowledge, culminating in the development of a model proficient in recognizing fruits from images [27]. Koirala, A. et al. demonstrated the superior performance of DL models in on plant fruit

Automated on-tree Mango Fruit Detection and Counting through Computer Vision

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Abstract

Using imaging and computer vision to precisely identify and quantify fruits at different stages of plant development is important not only to optimize labour-intensive manual measurements of phenotypic data but also to make significant progress towards task automation. The estimation of fruit yield plays a pivotal role in Precision Agriculture, aiding growers in more precisely forecasting market planning, workforce scheduling, procurement of suitable equipment, and other related considerations. There is also a high demand for automated methods to estimate fruit yield accurately and reliably in orchards. The advancements in Deep Learning models have been a great boon in this regard. In this work, YOLOv5 model is employed to detect and count mangoes on trees. The model has achieved a mean Average Precision@0.5 (mAP@0.5) as 99.5% and the mAP across the range of 0.5 to 0.95 as 81.9%, with a Mean Absolute Error (MAE) of 1.5 during testing.

Keywords: Computer Vision, labelImg, YOLOv5, mean Average Precision (mAP), Mean Absolute Error (MAE).

1.0. Introduction

The Indo-Burmese region is the origin of the mango (Mangifera indica Linn.), a dicotyledonous fruit belonging to the Anacardiaceae family. It is mostly produced in tropical developing nations; the estimated global production is 15.06 million tonnes [1]. For more than 4000 years, Ayurvedic and indigenous medical systems have valued the mango fruit. Ayurveda attributes various medicinal properties to various parts of the mango tree. Among all tropical fruits, mangoes are the most widely consumed. Mangiferin has potent antioxidant, anti-lipid peroxidation, immunomodulation, cardiotonic, hypotensive, wound healing, antidegenerative, and antidiabetic properties. It is a polyphenolic antioxidant and glucosyl xanthone [2]. The mango is India's most important fruit crop in terms of commerce, accounting for over 54% of all mangoes produced globally. There are more than thirty varieties of mangoes grown. Mango pulp's chemical makeup varies depending on the variety, maturity stage, and cultivation location. A soft, edible, ripe fruit with desirable qualities develops as a result of a series of physiological, biochemical, and organoleptic changes that occur during the fruit-ripening process [3]. Mangoes are prized for their hardiness and capacity to thrive in a variety of conditions in addition to their fruits. Mango trees have a long lifespan—they can live to be 100 years old and still produce fruit.

Using cutting-edge computer vision algorithms to analyse images and determine the presence and quantity of mangoes is a key component of deep learning techniques for mango detection and counting in trees. A review by V. Athanasios et al. highlights the dominance of deep learning methods, including Convolutional Neural Networks, Deep Boltzmann Machines, Deep Belief Networks, and Stacked Denoising Autoencoders, over traditional machine learning techniques in computer vision applications [4]. In the context of computer vision applications, J. Chai et al. identified eight emerging deep learning techniques: AlexNet, VGGNet, GoogLeNet & Inception, ResNet, DenseNet, MobileNets, EfficientNet, and RegNet. The analysis emphasizes the performance of these techniques in each task, categorizing recent developments into three stages and outlining future research directions in terms of both applications and techniques [5]. L. Yuzhi et al. utilized the bibliometric software Cite Space to perform visualization analysis on literature within the core database of Web of Science [6]. I. Guillermo et al. presented a comprehensive overview of Generative Adversarial Networks (GANs), encompassing the latest architectures, optimizations of loss functions, validation metrics, and application domains of widely acknowledged variants [7].

Ball pepper plant leaf bacterial spot disease was identified by M. P. Mathew et al. using YOLOv5 with mAP 90.7%. [8]. A. Sarda et al. demonstrated the application of YOLO to categorize road objects into distinct groups, achieving a mean Average Precision (mAP) of 74.6% in their study [9]. G. Dai et al. introduced a model for detecting and grading sprouted potatoes, achieving an accuracy of 90.14% and a mean Average Precision (mAP) of 88.1% through enhanced YOLOv5 model training [10]. In efforts to enhance productivity, I. Ahmad et al. devised a model employing the YOLOv5 algorithm for classifying and identifying crop-damaging insect pests. Furthermore, they introduced a smartphone-based automatic system with an impressive accuracy of 98.3% [11]. J. Ma et al. employed an improved YOLOv5 model for lotus seed pod detection, revealing a 0.7% accuracy improvement compared to the traditional YOLOv5s model [12].

W. S. Qureshi et al. employed K-nearest neighbour pixel classification and support vector machine classification to assess the quantity of fruits in images depicting mango trees [13]. O. E. Apolo-Apolo et al. applied deep learning techniques to compute the yield and size of citrus fruits using a UAV, with a standard error of 7.22% [14]. H. H. C. Nguen et al. successfully delved into a portion of deep learning algorithms, uncovering both their strengths and weaknesses. Through this exploration, they acquired knowledge in deep learning and constructed a model capable of recognizing fruits from images [15]. A. Koirala et al. reported that deep learning models excel in fruit-on-plant detection compared to pixel-wise segmentation techniques involving traditional machine learning, shallower CNNs, and neural networks [16]. M. Horea et al. explored deep learning algorithms to recognize fruits from images, leading to a comprehensive understanding of their strengths and weaknesses. The team developed a software capable of fruit recognition with accuracy 96.3% [17].

J. P. Vasconez et al. evaluated the performance of two widely used architectures, Faster R-CNN with Inception V2 and Single Shot Multibox Detector (SSD) with MobileNet, for fruit detection. The testing involved three types of fruits—Hass avocado and lemon from Chile, and apples from California, USA—across diverse field conditions. The results indicated that the system achieved high fruit counting accuracy, with Faster R-CNN and Inception V2 reaching up to 93% overall for all fruits, and SSD with MobileNet achieving 90% overall accuracy for all fruits [18]. I. Sa et al. presented a new method for fruit detection employing deep convolutional neural networks. They introduced multi-modal Faster R-CNN model showcased state-of-the-art performance, specifically excelling in sweet pepper detection. The model demonstrated an improvement in the F1 score, increasing from 0.807 to 0.838 compared to prior methods, highlighting enhanced precision and recall capabilities [19]. N. Hani et al. attained high yield estimation accuracies ranging from 95.56% to 97.83% in apple orchards. Notably, the fruit detection results revealed that the semi-supervised method, relying on Gaussian Mixture Models, outperformed the deep learning-based approach across all datasets [20]. M. Afonso et al. reported results in their study on detecting tomatoes in greenhouse images using the MaskRCNN algorithm. This algorithm not only identifies objects but also outlines the corresponding pixels for each detected object [21]. N. Mamdouh et al. introduced a framework that demonstrated notable performance metrics, including a precision of 0.84, a recall of 0.97, an F1-score of 0.9, and a mean Average Precision of 96.68% [22]. In the study conducted by H. Mirhaji et al., the YOLO-V4 model demonstrated superior performance for orange detection over test images, achieving precision, recall, F1-score, and mean Average Precision (mAP) of 91.23%, 92.8%, 92%, and 90.8%, respectively [23]. A. I. B. Parico et al. achieved a remarkable Average Precision (AP) at an intersection over union (IoU) of 0.50, with an impressive value of 98%, designating the YOLOv4-CSP model as the optimal choice in terms of accuracy of real time pear fruit detection and counting [24]. Y. Ge et al. computed the bounding box error by comparing the predicted bounding box with the one generated by the object detection network. This information was then used to update the parameters of the Kalman filter, and the process was iterated to achieve accurate tracking of both tomato fruits and flowers [25].

Literature reveals that YOLOv5 architecture has been employed in different domains and these models show good accuracy. Hence, in this work it is proposed to create a model for region-based fruit detection of on-tree mangoes using the deep learning YOLOv5 methodology, applying post-processing methods for accurate counting.

2.0. Materials and Methods

The study involves a comprehensive assessment of the Computer Vision based YOLOv5 deep learning technique aimed at addressing the task of detecting and counting mangoes on trees. The dataset utilized for this evaluation was curated using images gathered from internet sources. The Fig. 1 shows the proposed methodology of detection and counting.

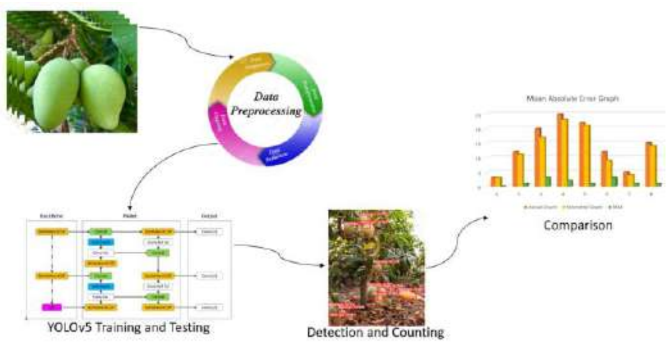

Fig. 1. Proposed methodology

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വിവേകാനന്ദസാഹിത്യത്തിന്റെ കാലികപ്രസക്തി

ഡോ. ജെ. പ്രസാദ്

മാധ്യമ ഭാഷാ വിചാരം

വി. വി. വേണുഗോപാൽ

ഓർമയിൽ തെളിഞ്ഞു തെളിഞ്ഞുവരുന്ന വരകൾ

ഡോ. മധു വാസുദേവൻ

സൂര്യനെ അടുത്തറിയാൻ ആദിത്യ

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അജിത വി.എസ്

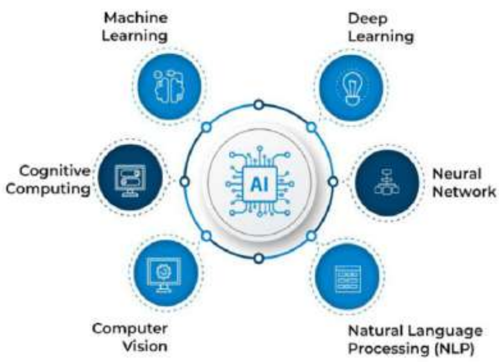
പി എസ് ഉണ്ണികൃഷ്ണൻ

മനുഷ്യനിർമ്മിത ബുദ്ധി

ഡോ. ശ്രീല എസ്.ആർ.

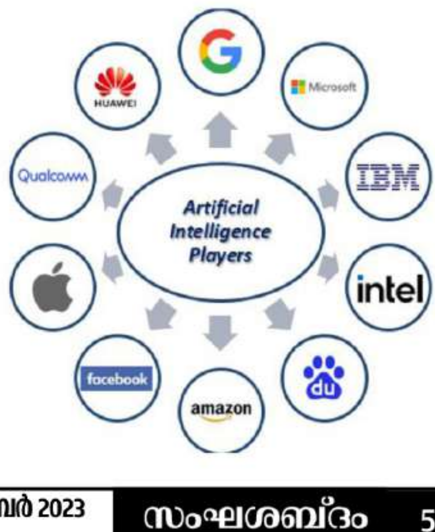
മനുഷ്യനിർമ്മിത ബുദ്ധി (ആർട്ടിഫിഷ്യൽ ഇന്റലിജൻസ്AI) എന്ന സാങ്കേതികവിദ്യയെ കുറിച്ച് ഈ ലേഖനം എഴുതാൻ തുടങ്ങിയ സമയത്താണ് ഒഡീസയിലെ ബാലേസോറിൽ മൂന്ന് ട്രെയിനുകൾ കൂട്ടിയിടിച്ചുള്ള അപകടമുണ്ടായത്. AI, ഇന്റർനെറ്റ് ഓഫ് തിങ്സ്, വയർലസ് സെൻസർ നെറ്റ്വർക്ക് പോലെയുള്ള സാങ്കേതിക വിദ്യകളുണ്ടായിട്ടും ഈ ഒരു അപകടമുണ്ടായത് വേദനാജനകമാണ്. നമ്മുടെ സംവിധാനങ്ങൾ നവീന സാങ്കേതിക വിദ്യകൾ വേണ്ടവിധത്തിൽ ഉപയോഗിക്കുന്നുണ്ടോ എന്ന് ചിന്തിക്കേണ്ടിയിരിക്കുന്നു. ആ അപകടത്തെ അനുസ്മരിച്ചുകൊണ്ടാണ് ഞാൻ ഈ ലേഖനം എഴുതാൻ തുടങ്ങുന്നത്.

മനുഷ്യമനസ്സുകൾ ചിന്തിക്കുന്നതുപോലെ കംപ്യൂട്ടറുകൾ ഉപയോഗിച്ച് പ്രശ്നങ്ങൾ ദൂരീകരിക്കാൻ വേണ്ടി വികസിപ്പിച്ചെടുത്ത സാങ്കേതികവിദ്യയാണ് നിർമ്മിത ബുദ്ധി. AI യുടെ പ്രധാനപ്പെട്ട ഘടകങ്ങളാണ് താഴെ ചിത്രത്തിൽ രേഖപ്പെടുത്തിയിരിക്കുന്നത്.



പ്രമുഖ ഐ റ്റി കമ്പനികൾ AI യുടെ ഗവേഷണപ്രവർത്തനങ്ങൾക്കായി ധാരാളം മൂലധനം ഉപയോഗിക്കുന്നുണ്ട്. ചൈനയാണ് AI ഗവേഷണത്തിൽ മുൻപന്തിയിലുള്ള രാജ്യം. ചൈനയുടെ ജിഡിപി യുടെ 26.1% AI വ്യവസായങ്ങളിൽ നിന്നുമാണ്.

താഴെ ചിത്രത്തിൽ രേഖപ്പെടുത്തിയിരിക്കുന്ന IT കമ്പനികളാണ് AI യുടെ മുഖ്യ ഉപഭോക്താക്കൾ. ഈ കമ്പനികൾ IT മേഖലയിൽ കൂടാതെ ശാസ്ത്രത്തിലും ആരോഗ്യമേഖലയിലും ഉൾപ്പെടെ വിവിധ മേഖലകളിൽ AI യുടെ സാദ്ധ്യതകൾ കണ്ടെത്തുന്നു.



ആപ്ലിക്കേഷനുകൾ

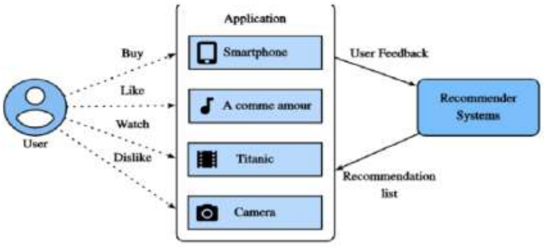
ഒരു വിധത്തിൽ അല്ലെങ്കിൽ മറ്റൊരു തരത്തിൽ നിത്യ ജീവിതത്തിൽ AI ഒരു വലിയ പങ്ക് വഹിക്കുന്നുണ്ട്. AI യുടെ പല പ്രവർത്തനമേഖലകളാണ് ചുവടെ വിവരിക്കുന്നത്:

1. ആധുനിക രീതിയിലുള്ള വെബ് സെർച്ച്

ജനറേറ്റിവ് നിർമ്മിത ബുദ്ധി വെബ് സെർച്ച് വളരെ വേഗത്തിലും കാര്യക്ഷമമായും പുതിയ ആശയങ്ങൾ കണ്ടെത്താനും സഹായിക്കുന്നു. ഇത് ഉപയോഗിക്കുന്ന വെബ് സെർച്ച് എഞ്ചിനുകൾക്കു ഉദാഹരണമാണ് ഗൂഗിൾ വെബ് സെർച്ച്, മൈക്രോസോഫ്റ്റിന്റെ Bing AI , ഒപേര വെബ് സെർച്ച് എന്നിവ.

2. റെക്കമെന്റഷൻ സിസ്റ്റംസ്

ഉപഭോക്താക്കൾക്ക് ഉതകുന്ന രീതിയിൽ ആവശ്യങ്ങൾ ഏകീകരിക്കാൻ വേണ്ടി റെക്കമെന്റഷൻ സിസ്റ്റംസ് ഒരു ഏജന്റായി വർത്തിക്കുന്നു. AI അൽഗോരിതം ഉപയോഗിച്ച് ഉപഭോക്താവിന് അവരുടെ താല്പര്യമുള്ള സാധനങ്ങളുടെ ലിസ്റ്റ് തയ്യാറാക്കുകയും ആവശ്യമുള്ള നിർദ്ദേശങ്ങളും ഈ സംവിധാനം തരുന്നു. നെറ്റ്ഫ്ലിക്സ്, യൂട്യൂബ്, ഫേസ്ബുക്ക്, ഫ്ളിപ്കാർട്ട് , ആമസോൺ തുടങ്ങിയ സാമൂഹിക മാധ്യമങ്ങളിൽ ശുപാർശകൾ വരുന്നത് ഈ സാങ്കേതികവിദ്യ ഉപയോഗിച്ചാണ്.



3. ഇന്റർനെറ്റ് ഓഫ് തിങ്ങ്സ് (Internet of Things)

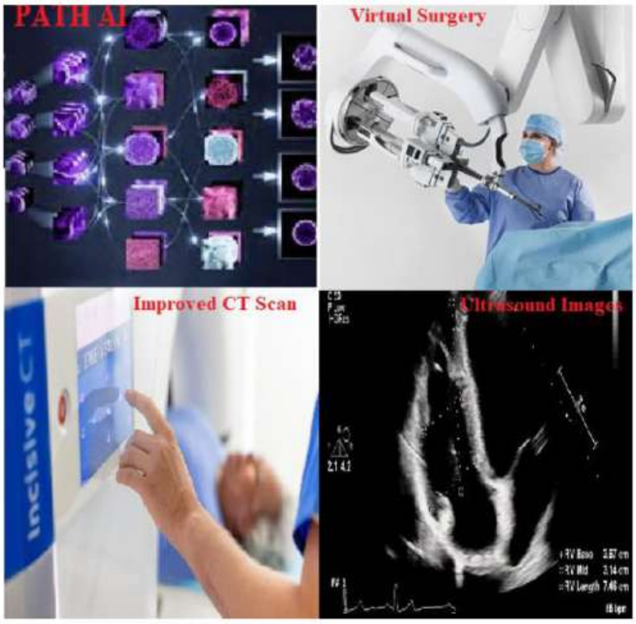
ലോകത്തെ എല്ലാ വസ്തുക്കളും തമ്മിൽ ആശയ വിനിമയം ചെയ്യാൻ ഉപയോഗിക്കുന്ന ഒരു സാങ്കേതിക വിദ്യയാണ് ഇന്റർനെറ്റ് ഓഫ് തിങ്ങ്സ്(IOT). AI യും IOT യും കൂടി സംയോജിപ്പിക്കുന്ന മേഖലയെ വസ്തുക്കളുടെ നിർമ്മിത ബുദ്ധി (Artifical Intelligence of Things AIOT) എന്ന് പറയുന്നു. സ്മാർട്ട് സിറ്റി, സ്മാർട്ട് ഹോം, സ്മാർട്ട് ഓഫീസ്, ഓട്ടോണോമസ് വെഹിക്കിൾസ്, സാമൂഹിക മാധ്യമങ്ങളിലും AIOT ധാരാളമായി ഉപയോഗിക്കുന്നുണ്ട്. ഗൂഗിൾ കാർ ഓട്ടോണോമസ്(ഡ്രൈവറില്ലാത്ത) വെഹിക്കിളിന് ഒരു ഉദാഹരണമാണ്.

ചരിത്രം

- ഗ്രൗണ്ട് വർക്ക് (1900–49)
- 1990 ആദ്യ കൃത്രിമ മനുഷ്യനെ നിർമ്മിക്കാനുള്ള പ്രവർത്തനങ്ങൾ തുടങ്ങി
- 1921 കാറൽ കാപാക്കിന്റെ ഫിക്ഷൻ നാടകത്തിലാണ് ആദ്യമായി റോബോട്ട് എന്ന ആശയം ഉപയോഗിച്ചത്.
- ഉത്ഭവം (1950–56)
- 1950 അലൻ ട്യൂറിംഗ് മെഷീന്റെ ബുദ്ധി മനസ്സിലാക്കാൻ വേണ്ടി ഇമിറ്റേഷൻ ഗെയിം ഉണ്ടാക്കി.
- 1955 ജോൺ മക്കാർത്തി എന്ന ശാസ്ത്രജ്ഞനാണ് ആർട്ടിഫിഷ്യൽ ഇന്റലിജൻസ് എന്ന പദം ആദ്യമായി ഉപയോഗിച്ചത്.
- പൂർണ്ണവികാസം (1958–1979)
- 1958 ജോൺ മക്കാർത്തി ലിസ്പ്(LISP) എന്ന ആദ്യത്തെ AI പ്രോഗ്രാമിങ് ലാംഗ്വേജ് നിർമ്മിച്ചത്.
- 1959 ആർതർ സാമുവേൽ ആദ്യമായി മെഷീൻ ലേണിംഗ് എന്ന ആശയം കൊണ്ടുവന്നത് .
- 1965 ആദ്യത്തെ expert സിസ്റ്റം നിർമ്മിച്ചു .
- 1966 ആദ്യത്തെ ചാറ്റ്ബോട്ട് കണ്ടുപിടിച്ചു .
- 1979 അമേരിക്കൻ അസോസിയേഷൻ ഓഫ് ആർട്ടിഫിഷ്യൽ ഇന്റലിജൻസ്(AAAI) സ്ഥാപിച്ചു.
- കുതിച്ചുചാട്ടം (1980–87)
- 1980 AAAI യുടെ ആദ്യസമ്മേളനം നടന്നു. ആദ്യ expert സിസ്റ്റമായ XCON വിപണിയിലെത്തി.
- 1981 ജാപ്പനീസ് ഗവൺമെന്റ് AI ഉപയോഗിച്ചുള്ള അഞ്ചാമത്തെ തലമുറ കമ്പ്യൂട്ടർ നിർമ്മിക്കാനുള്ള ഫണ്ട് വകയിരുത്തി.
- 1985 ആരോൺ എന്ന സ്വയം വരയ്ക്കുന്ന പ്രോഗ്രാം വികസിപ്പിച്ചു.
- 1986 ആദ്യത്തെ ഡ്രൈവറില്ലാത്ത കാർ ഉണ്ടാക്കുകയും പരീക്ഷിക്കുകയും ചെയ്തു.
- ശീതകാലം (1987–93)
- ഈ കാലയളവിൽ വളരെ കുറച്ച് ഫണ്ട് മാത്രമേ AI ഗവേഷണത്തിന് വേണ്ടി ഉപയോഗിച്ചുള്ളൂ.
- ഏജന്റ്സ് (1993 –2011)
- 1997 ഐബിഎം വികസിപ്പിച്ച ഡീപ്പ് ബ്ലൂ എന്ന ചെസ്സ് പ്രോഗ്രാം ലോക ചെസ്സ് ചാമ്പ്യൻ ഗാരി കാസ്പറോവിനെ തോൽപ്പിച്ചു. ഡ്രാഗൺ സിസ്റ്റം എന്ന കമ്പനി ഒരു സ്പീച്ച് മനസ്സിലാക്കുന്നതിനുള്ള സോഫ്റ്റ്‌വെയർ ഉണ്ടാക്കി.
- 2000 ആദ്യമായി വികാരങ്ങളുള്ള കിസ്മേറ്റ് എന്ന് പേരുള്ള റോബോട്ടിനെ നിർമ്മിച്ചു.
- 2006 ട്വിറ്റർ,ഫേസ്ബുക്ക്, നെറ്റ്ഫ്ലിക്സ് എന്നീ കമ്പനികൾ AI ഉപയോഗിക്കാൻ തുടങ്ങിയത്.
- 2010 മൈക്രോസോഫ്ട് ആദ്യത്തെ AI ഉപയോഗിച്ചുള്ള ഗെയിമിംഗ് ഹാർഡ്‌വെയർ വിപണിയിലെത്തിച്ചു.
- 2011 ഭാഷാപ്രോസസ്സിങ് ചെയ്യുന്ന ഐബിഎം വാട്സൺ എന്ന സോഫ്റ്റ്‌വെയർ വികസിപ്പിച്ചു. ആപ്പിളിന്റെ സിരി വിപണിയിലെത്തി .
- ആർട്ടിഫിഷ്യൽ ജനറൽ ഇന്റലിജൻസ്(2011)
- 2016 സോഫിയ എന്ന റോബോട്ടിനെ ഉണ്ടാക്കി. ആദ്യമായി ഒരു രാജ്യത്തിന്റെ പൗരത്വം കിട്ടിയ റോബോട്ടാണ് സോഫിയ.
- 2018 ആലിബാബയുടെ ഭാഷാപ്രോസസ്സിങ് സോഫ്റ്റ്‌വെയർ വിപണിയിലെത്തി.
- 2020 ഓപ്പൺ AI എന്ന സ്ഥാപനം GPT3 പരീക്ഷണങ്ങൾ ആരംഭിച്ചു.
- 2021 ഓപ്പൺ AI ചിത്രങ്ങളുടെ വിവരങ്ങൾ തരുന്ന DALLE സോഫ്റ്റ്‌വെയർ വികസിപ്പിച്ചു.
- 2022 ചാറ്റ് ജിപിടി ഉപയോഗയോഗ്യമായി

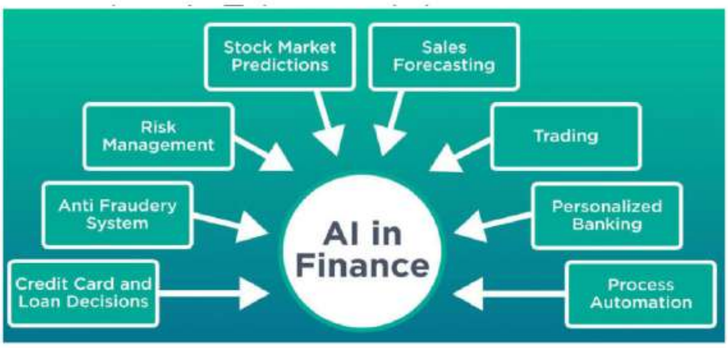
4. ആരോഗ്യമേഖല

വിവിധ രോഗങ്ങൾ കണ്ടുപിടിക്കുന്നതിലും മെഡിക്കൽ ഡേറ്റയെ ചിത്രീകരിക്കുന്നതിലും ടെലിമെഡിസിനിലും ആരോഗ്യ വിവരങ്ങൾ സൂക്ഷിക്കുന്നതിലും മരുന്നുകൾ കണ്ടുപിടിക്കുന്നതിൽ പോലും ആർട്ടിഫിഷ്യൽ ഇന്റലിജൻസ് സാങ്കേതികവിദ്യ വളരെ വ്യാപകമായ തോതിൽ പ്രയോഗിക്കുന്നു. IBM ന്റെ വാട്സൺ ഓൺകോളജി, പാത്ത് AI (Path AI), മൈക്രോസോഫ്ടിന്റെ ഹാൻ ഓവർ പ്രൊജക്റ്റ്, ഗൂഗിളിന്റെ ഡീപ്പ് മൈൻഡ് എന്നിവ ആരോഗ്യമേഖലയിലുള്ള പോപ്പുലർ ആപ്ലിക്കേഷൻസാണ്. ധാരാളം കമ്പനികൾ ആരോഗ്യസ്ഥാപനങ്ങളുമായി ചേർന്ന് AI എന്ന സാങ്കേതിക വിദ്യ മനുഷ്യജീവന് സഹായമാകുംവിധം ധാരാളം പ്രവർത്തനങ്ങൾ നടത്തിവരുന്നു.



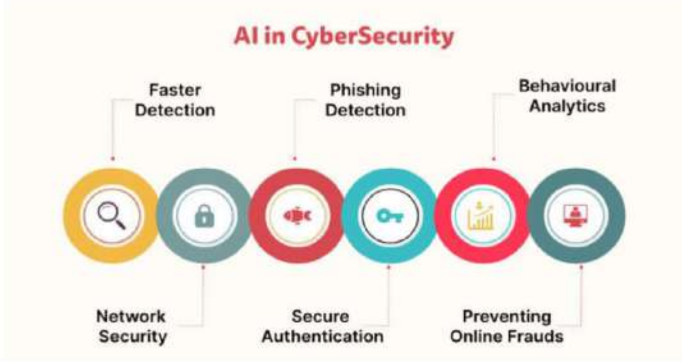
5) സാമ്പത്തികമേഖല

സാമ്പത്തികമേഖലയിൽ ഉപഭോക്താക്കളുടെ അഭിരുചി മനസ്സിലാക്കി സേവനങ്ങൾ നൽകാനും തത്സമയ സംശയ ദൂരീകരണത്തിനും AI സഹായിക്കുന്നു. കൂടാതെ ബാങ്കിങ്ങിലെ ദിനംപ്രതി സേവനങ്ങളായ അക്കൗണ്ട് ബാലൻസ് അറിയുന്നതിനും പാസ്സ്‌വേർഡ് പുനഃസജ്ജമാക്കുന്നതിനും കസ്റ്റമർ എക്സിക്യൂട്ടീവുമായി സംവദിക്കുന്നതിനും ഇതുപയോഗിക്കുന്നു.



6) സൈബർ സുരക്ഷ

സൈബർ പ്രതിസന്ധികൾ, വിദ്വേഷ പ്രവർത്തനങ്ങൾ എന്നിവ മുൻകൂട്ടി കണ്ടുപിടിക്കുന്നതിനു AI മോഡൽസ് ഉപയോഗിക്കുന്നു. ഇത് വഴി സൈബർ ആക്രമണങ്ങളുടെ തീവ്രത കണ്ടുപിടിക്കാനും കുറ്റവാളികളെ വേഗത്തിൽ കണ്ടുപിടിക്കാനും സാധിക്കുന്നു.



7) റോബോട്ട്

AI റോബോട്ടുമായി സംയോജിപ്പിച്ചാൽ റോബോട്ടിന്റെ കഴിവുകൾ കൂട്ടാനും അതിന്റെ ചിന്താശേഷി വർധിപ്പിക്കാനും സാധിക്കും. റോബോട്ടിക്സിൽ ഉപയോഗിക്കുന്ന AI യുടെ ഒരു സാങ്കേതിക വിദ്യയാണ് മെഷീൻ ലേർണിംഗ്. റോബോട്ടുകൾ ചുറ്റുപാടുകളിനിന്നും മനുഷ്യന്റെ പ്രവർത്തികൾ നിരീക്ഷിച്ചു പഠിക്കുന്നു.റോബോട്ടുകൾ കസ്റ്റമർ സെർവീസിനും വ്യവസായ സ്ഥാപനങ്ങളിൽ സാധനങ്ങൾ അസ്സെംബിൾ ചെയ്യാനും പാക്കിങ്ങിനും സഹായിക്കുന്നു.

1. Sophiya

2.Atlas and spot

3. HRP-5P

4. Aquanaut

8) വെർച്ചൽ അസിസ്റ്റന്റ് (VA)

ടെക്സ്റ്റ്(വാചകം), ശബ്ദം എന്നിവ മൂലം മനുഷ്യനുമായി സംവേദനം നടത്തുന്ന ഒരു പ്രോഗ്രാമാണ് ചാറ്റ് ബോട്ട്. ഓപ്പൺ AI യുടെ ചാറ്റ് ജിപിറ്റി, ഗൂഗിളിന്റെ മീന, മൈക്രോസോഫ്റ്റിന്റെ ടേ(Tay) എന്നിവയെല്ലാം ചാറ്റ് ബോട്ടിന് ഉദാഹരങ്ങളാണ്. Virtual Assistant മനുഷ്യന് വിവിധ കാര്യങ്ങളിൽ സഹായങ്ങൾ നൽകുന്നു. ആമസോണിന്റെ അലെക്സ, ആപ്പിളിന്റെ സിരി, ഗൂഗിൾ അസിസ്റ്റ് മുതലായവ VA ആണ്.

9) ശാസ്ത്ര മേഖല

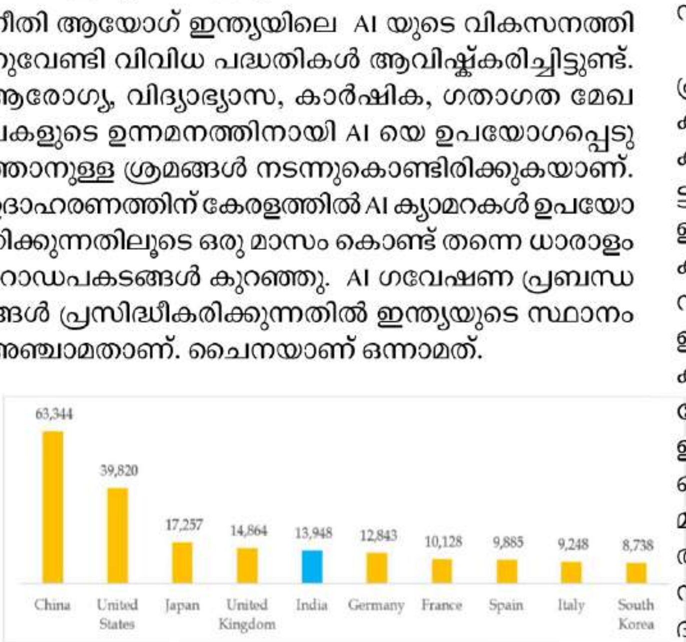
AI ഭൗതികശാസ്ത്ര മേഖലയിലും രസതന്ത്രത്തിലും ജീവശാസ്ത്രത്തിലും കാർഷിക മേഖലയിലും എല്ലാം ഗവേഷണങ്ങൾ വേഗത്തിലാക്കുന്നുണ്ട്. ഗാലക്സിയെ തരംതിരിക്കാനും നക്ഷത്രങ്ങളെ കണ്ടുപിടിക്കുന്നതിനും നിലവിലുള്ള വിവിധ ഡേറ്റയിൽ നിന്നും പാറ്റേൺ മനസ്സിലാക്കുന്നതിനും ഫിസിക്സിൽ ഇതുപയോഗിക്കുന്നു. പ്രോട്ടീൻ ഘടന , വിവിധ മരുന്നുകൾ , രോഗങ്ങൾ എന്നിവ ഇതിന്റെ സഹായത്താൽ കണ്ടുപിടിക്കുന്നു. തന്മാത്രകൾ നിർമ്മാണം മുതൽ തന്മാത്രകളുടെ സ്വഭാവം തിരിച്ചറിയാൻ വരെ ഇത് സഹായിക്കുന്നു.

10) ഭാഷാഗവേഷണം

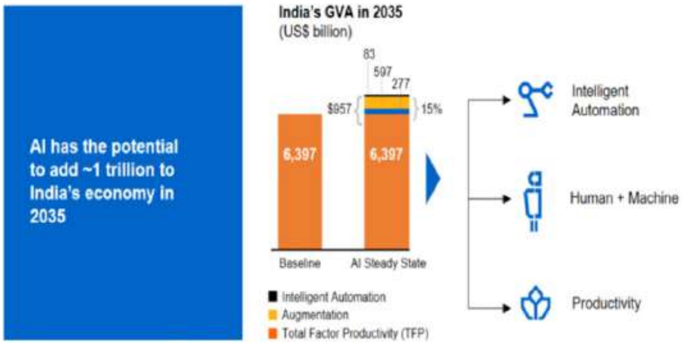
വിവിധ ഭാഷകൾ പ്രോസസ്സ് ചെയ്യുന്നതിനും, വാചകങ്ങൾ നിർമ്മിക്കുന്നതിനും AI സഹായിക്കുന്നു. ഗൂഗിൾ ട്രാൻസ്ലേറ്റ് വിവിധ ഭാഷകളിലെ വാചകങ്ങൾ മറ്റൊരു ഭാഷയിലേക്കു മാറ്റാനുപയോഗിക്കുന്നു. ഭാഷാപ്രോസസ്സിംഗ് , നിഘണ്ടുനിർമാണം , ഭാഷാജനറേഷൻ എന്നിവ ഭാഷാഗവേഷണത്തിന്റെ പല മേഖലകളാണ്.

AI യിൽ ഇന്ത്യയുടെ വളർച്ചകൾ

നീതി ആയോഗ് ഇന്ത്യയിലെ AI യുടെ വികസനത്തിനുവേണ്ടി വിവിധ പദ്ധതികൾ ആവിഷ്കരിച്ചിട്ടുണ്ട്. ആരോഗ്യ, വിദ്യാഭ്യാസ, കാർഷിക, ഗതാഗത മേഖലകളുടെ ഉന്നമനത്തിനായി AI യെ ഉപയോഗപ്പെടുത്താനുള്ള ശ്രമങ്ങൾ നടന്നുകൊണ്ടിരിക്കുകയാണ്. ഉദാഹരണത്തിന് കേരളത്തിൽ AI ക്യാമറകൾ ഉപയോഗിക്കുന്നതിലൂടെ ഒരു മാസം കൊണ്ട് തന്നെ ധാരാളം റോഡപകടങ്ങൾ കുറഞ്ഞു. AI ഗവേഷണ പ്രബന്ധങ്ങൾ പ്രസിദ്ധീകരിക്കുന്നതിൽ ഇന്ത്യയുടെ സ്ഥാനം അഞ്ചാമതാണ്. ചൈനയാണ് ഒന്നാമത്.



2035 നകം AI യിൽ നിന്നും ഇന്ത്യയുടെ വരുമാനം 1 ട്രില്യൻ ആക്കാനാണ് ശ്രമം.



ഇന്ത്യയിൽ IIT , IISC , IIST , NIT , വിവിധ സർവകലാശാലകളിലും AI ഗവേഷണം നടക്കുന്നുണ്ട്.

കേരളത്തിന്റെ സംഭാവനകൾ

ഇന്ത്യയിലെ ആദ്യത്തെ ഡിജിറ്റൽ സയൻസ് പാർക്ക് കേരളത്തിലാണ്. അവിടെ AI യുമായി ബന്ധപ്പെട്ട പ്രൊജെക്റ്റുകൾ ചെയ്യുന്ന കമ്പനികളും സ്റ്റാർട്ട് ആപ്പുകളും ഡിജിറ്റൽ യൂണിവേഴ്സിറ്റിയും പ്രവർത്തിക്കുന്നു . കേരളത്തിൽ കെൽട്രോണിന്റെ സഹായത്താൽ പ്രവർത്തിക്കുന്ന AI ക്യാമറ ഗതാഗത മേഖലയിൽ വൻമുന്നേറ്റമാണ് നടത്തിക്കൊണ്ടിരിക്കുന്നത്. പല ഇന്ത്യൻ സംസ്ഥാനങ്ങളും അതിന മാതൃകയാക്കാൻ ഒരുങ്ങുന്നു. സിഡാക്, തിരുവനന്തപുരം വികസിപ്പിച്ചെടുത്ത സെർവിസ്കാൻ എന്ന സോഫ്റ്റ്‌വെയർ സ്ത്രീകളിലെ സെർവിക്കൽ കാൻസർ ആദ്യഘട്ടത്തിൽ കണ്ടുപിടിക്കാൻ ഉപയോഗിക്കാം. കേരളത്തിലെ വിവിധ IT പാർക്കുകളിൽ AI കമ്പനികൾ പ്രവർത്തിക്കുന്നു. ഐസിഫോസ് (ICFOSS) മലയാളം പ്രോസസ്സിങ്ങിനു ആവശ്യമായ നിഘണ്ടുവും അൽഗോരിതങ്ങളും നിർമ്മിക്കുന്നുണ്ട്. കേരളത്തിലെ വിവിധ സർവകലാശാലകളും പൊതുമേഖലാ സ്ഥാപനങ്ങളും ഗവേഷണ പ്രബന്ധങ്ങൾ ഈ മേഖലയിൽ സമർപ്പിക്കുന്നുണ്ട്.

ആധുനിക ലോകത്തിൽ മനുഷ്യന്റെ ദൈനംദിന പ്രവർത്തനങ്ങളെ AI വലിയരീതിയിൽ സ്വാധീനിക്കുന്നുണ്ട്. നിർമ്മിത ബുദ്ധിക്കു ഒരു അഞ്ച് വയസ്സുകാരന്റെ ബുദ്ധിയെയായിട്ടുള്ളുവെന്നാണ് കമ്പ്യൂട്ടർ ശാസ്ത്രജ്ഞന്മാർ പറയുന്നത്. എന്നിരുന്നാലും ഇപ്പോൾ നമ്മളെ സ്വാധീനിക്കുന്ന എല്ലാ മേഖലകളിലും AI കടന്നു കയറിക്കൊണ്ടിരിക്കുകയാണ്. നമ്മുടെ പ്രവർത്തനങ്ങളെ വളരെ വേഗം ചെയ്യാൻ ഇത് സഹായിക്കുന്നു. നമ്മുടെ ജോലി സാദ്ധ്യതകൾ പല മേഖലകളിലും കുറയുമെങ്കിലും വേറെ മേഖലകളിൽ ജോലി സാധ്യത കണ്ടുപിടിക്കേണ്ടി ഇരിക്കുന്നു. ചാറ്റ് ജിപിറ്റി പോലെയുള്ള ഉപകരണങ്ങൾ ഉപയോഗിക്കുമ്പോൾ നമ്മുടെ സൃഷ്ടിപരമായ കഴിവുകൾ കുറയാനുള്ള സാധ്യതയേറുന്നു. അതുകൊണ്ട് AI എന്ന സാങ്കേതിക വിദ്യയുടെ നല്ല സാദ്ധ്യതകൾ പ്രയോജനപ്പെടുത്തി നമുക്ക് ഏറെ ദൂരം പോകാനുള്ളതാണ്.