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Rice Quality Analysis by Using Deep Convolutional Neural Network

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***Abstract*—**
Riceisavitalfoodcropthatplaysacrucialroleinensuring food security worldwide. The quality of rice grains is acritical factor that determines its market value and its suitabilityfor human consumption. Traditional methods of assessing ricequality are time-consuming, expensive, and subjective. In thispaper, we propose a deep learning-based approach for analysingthequalityofricegrainsandclassifyingthemintodifferentcategories. Our approach involves the use of VGG16 model toautomatically extract features from rice grain images and classifythem based on their quality. We trained our VGG16 on a datasetof rice grain images,which were annotated withinformationontheirquality.Thedatasetwasdividedintothree qualitycategories:high,medium,andlow.Weusedapre-processingstepto normalize the images and remove any noise. We then trainedourVGG16 using a supervised learning approach,optimizingthe cross-entropy lossfunctionwith the Adamoptimizer.Weevaluatedtheperformanceofourapproachonaseparatetestset ofrice grains,whichwere notused in the training phase.Our experimental results show that our proposed deep learning-based approach achieved a better accuracy in classifying ricegrains into different qualitycategories.Wealsoperformedasensitivity analysis to investigate the impact of various factors,suchasimageresolutionandnetworkarchitecture,onthepe rformance of our approach. Our results suggest that higherimage resolution and deeper network architectures can improvethe accuracy ofour method. Our proposed approach has thepotential to revolutionize the riceindustry byproviding an automated,objective,andefficientwayof analyzing the quality of rice grains. The proposed method can be used to ensure that ricemeets the required standards for human consumption, leading tobetter food security and safety. Keywords—: Grading, rice grain,ConvolutionalNeuralNetwork(CNN),VGG-16(VisualGeometryGroup)

***IndexTerms*—component,formatting,style,styling,insert**

I. INTRODUCTION

Riceisasignificantfoodcropthatisconsumedbyasignificant portion of the world's population. The quality ofrice grains is a critical factor that affects its market value andits suitability for human consumption. The traditional methodof assessing rice quality is throughmanual inspection,whichis time-consuming, expensive, and subjective. The advent ofdeeplearninghasopenednewpossibilitiesforautomatingtherice grainquality analysis process.Inthis paper,we proposea deep learning-based approach for analysing the quality ofrice grains and classifying them into different categories. Oneof the most significant and widely consumed cereal grains inPakistan and the entire world is rice. The caloric intake forhuman nutrition is also of utmost importance. In average, itcontains 3Pakistan is renowned for producing three variousvarieties of rice, including aromatic, medium, and round grainrice, as a result of its favourable agro-climatic conditions. Theprincipal nations that produce rice are China, Pakistan, India,Indonesia,andVietnam.Itis

Pakistan's second main dietary staple after wheat. With anannual production of 9.935 million metric tonnes, Pakistan isamong the top twenty rice producers, according to the mostrecent rankings. It is a significant cash crop as well. With anexport of 38,00,000 metric tonnes annually, Pakistan is thefifth-largest exporter of rice. They grow basmati rice, kernelrice, kainat rice, khushboo rice, super basmati rice, kainatsailarice, and non-basmati long and short grain rice. All the nationsthatproduce rice are working hard to raise the standard oftheircrop.Ricemustbeproperlyinspectedforquality.Thus,it is vital to provide anautomatedmethodfor classifyingandevaluatingthequalityofvariousricegrainkinds.InPakistan, many software programmes, like the rice server andCompute rice programmes created by AGsoft and Softronix,respectively, are utilised in various mills to automate all oper-ations. Nevertheless, there is no locally produced software forquality analysis and categorization, hence the majority of ricemills use the Australian-made SATAKE RSQI10A Rice grainscanner software instead. The primary goal of this system is toprovide a low-cost automated solution for the categorizationand quality assurance of rice grains. Quality analysis utilisingthe IVP approach is a well-known study area and is preferredto traditionaltechniquesforanalysisbecauseto itssimpledeployment, lack of human intervention, cost effectiveness,andquickturnaroundtime.Forthecategorizationofricevarieties,amethodbasedontheintegrationofprincipalcomponent analysis and canny edge detection is applied. Yet,themanymorphologicalcharacteristicsofgrains,suchasthemainandminoraxislength,
eccentricity,perimeter,andareaofrice grains, will determine the quality of the grain. The processbegins with the acquisition of a picture using a colour digitalcamera, followed by pre processing, background estimation,and

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RGB to binary conversion. The second stage is to createthedatabaseforthesystem'straining.Atleast100 photosof each type of rice with a white background are fed to thesystem during training. The data base pictures' morphologicalattributes, eigen values, and vectors will all be kept as data.Once trainingis completed,the systemcanexamine grainquality and recognise the kindof rice.

Sampleimageswillbe compared to databases forrice graincategorization andquality analysis. Afterthat, pre processing, smoothing, andbackgroundestimationareappliedto theacquiredimages.After estimating the backdrop, the grain picture is convertedfromRGB to binary,withthegrainbeingdivided.Then,inordertocomputethe variousmorphologicalproperties,canny edge detectors are used to identify the edges of grains.Certainmorphologicalcharacteristics,suchasaxislength ,perimeter, eccentricity, and area, will affect the rice's quality.The eigenvalues and grain vectors are computed using cal-culated morphological characteristics. The sample image willautomatically go through the same processes. By contrastingthesamplepicture,classificationandqualityanalysis arecarriedout.

II. Existing System

Rice quality is a combination of its physical and chemicalcharacteristics. Rice's chemical characteristics include amy-lose content, gelatinization temperature, and gel consistency,whilst certain physical characteristics include grain size andshape,chalkiness, and whiteness. The paper providesawayforcategorisingandevaluatingricegrainsbasedo ntheir shapeandsize,namelyby employingedgedetectionalgorithms,CNN algorithms, and SVM in machine processing techniquesto determine the region of each grain's borders. Support vectormachines are employed in this approach to classify solely theprospects of the rice grain as excellent or bad. This approachattempts to categorise solely the characteristics of excellentandpoorricegrains.

III. Literature Study And Related Works

AUTHORKoklu,M.,Cinar,I.,Taspinar,Y.S.(2021).TITLECla ssification ofricevarietieswith deeplearningmeth-ods.DESCRIPTION: Riceisoneofthecropswiththegreatestgenetic diversity when it comes to grain products producedglobally. These types canbe distinguished from one anotherby some of these traits. In most cases, traits including texture,form, and colour are present. Using these traits that distinguishthe various typesof rice,itis feasible toclassify andscorethe quality of seeds. This study used the five most popularvarieties of rice grown in Turkey: Arborio, Basmati, Ipsala,Jasmine, and Karacadag. 75,000 grain images altogether, with15,000 of each kind, make up the collection. A second datasetof 106 characteristics was used, which was constructed usingthefeaturesderivedfromtheseimages.Thesecharacteristi cscomprised 90 colour features, 4 form features, and 12 mor-phological traitsModels for the feature dataset were createdusingConvolutionalneuralnetworks(CNN)andArtifici alneural networks (ANN), whereas models for the image datasetwere created using Deep Neural Networks (DNN), Artificialneural networks (ANN), and Deep Neural Networks (DNN).Thestatisticalfindingsofsensitivity,specificity,predict ion,F1score,accuracy,falsepositiverate,andfalsenegativerate werecomputed using the confusion matrix values of the models.Tables are used to illustrate the outcomes for each model. ForANN, DNN, and CNN, respectively, the models' classifica-tion success rates were 99.87AUTHOR: Abbaspour-Gilandeh,Y.,Molaee,A.,Sabzi,S.,Nabipur,N.,Shamshirband, S.,Mosavi,A.(2020).TITLE:atechniqueforidentifying 13Iranian rice varieties using an artificial neural network andimage processing together. DESCRIPTION: The developmentof aprecise evaluationof cultivars isseenas necessary dueto the significance of recognising agricultural cultivars. Theproceduresthatare now usedtoidentify ricecultivars aremostly time-consuming, expensive, and damaging. Therefore,it is quite advantageous to designfreshways.The currentstudy'sobjectiveistouseartificialintelligence(AI)techn iquestocategorisepopularricevarietiesinIranbasedontheircolo ur,morphological,andtexturalcharacteristics.Indoingso,MAT LAB is used to segment and pre-process digital picturesof 13 rice cultivars from Iran that are available in the paddy,brown, and white varieties. For each rice cultivar, 92 speci-ficities were found, comprising 60 colour, 14 morphological,and 18 texture traits. The data's normality was assessed in thefollowingstage, andusingvarianceanalysis,the likelihoodof finding a significant difference between all cultivar-specifictraits was investigated. Inorderto compare cultivars moreaccurately, the least significant difference(LSD)testwasalso carriedout.Principalcomponent analysis(PCA)wasusedto condense the dimensions of the data and concentrateon the most useful components. Accordingly, paddy, brown,andwhiterice'saccuracyofricecultivarseparationswasc alculated using discriminant analysis (DA), and the resultswere 89.2AUTHOR Silva, C. S., Sonnadara, D. U. J. (2013).TITLE Classificationof ricegrains using neural networks.DESCRIPTION:Thecategorizationofricetypesusin ganeural network is presented in thisresearch.Ninedistinctrice varieties were taken into account forthe investigation.Every variety was represented by samples, and pictures of theseedsweretaken.13morphologicalfeatures,6colourfeatures ,and 15 texture features were all extracted using algorithmsfrom colour photographs of individual seed samples. Differentneural network models were created for the combined featureset and the distinct feature sets. Textural characteristics, asopposed to morphological and colour features, provided highclassification accuracy. The combined feature model yieldedanoverallclassificationaccuracyof92

IV. Proposed Methodology

A. *Proposedapproach*

The recommended method provides a less expensive andtime-consuming alternative to quality analysis. Much progresshasbeenmadeinthe very importantand cutting-edgefieldof imageprocessing.Thetraditionalhumansensorypanelis being replaced, and work is being done on it.The systemarchitecture describes the procedures followed in this

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work todetermine the rice quality accurately. The two main processesareimagecategorizationandpictureprocessing.Aftert hepredictionprocess, we use VGG-16 to classify the variousvarietiesof rice.someshapeorform.Therearefew manyriceimagesintheinternetsource

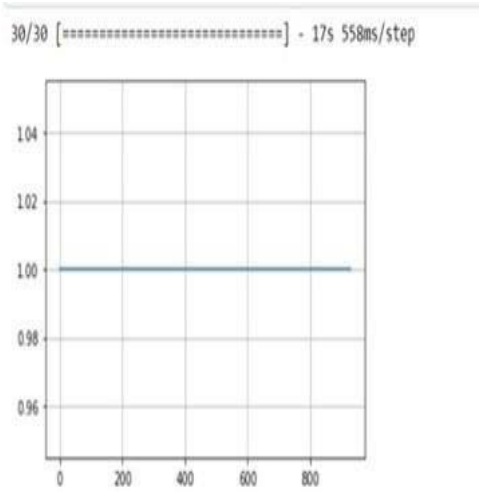

Fig.1.Approachingmorphologicalfeatures

B. *Data pre-processing*

The pre-processing of data is an essential stage in models isto create networks that require the correct input data format.This model requires huge datasettoobtainhighaccuracyandperformance.Machinelearni ngresearchersuseddataaugmentationwhich helps inincreasing images. This is doneto increase the data set and give the neural network differentimage options. This makes the model more likely to recognizeanobjectwhenitappearsin

C. *vgg-16-visualgeometrygroup*

TodayVGG-16istobeconsideredanexcellentdeeplearningnetwork.Theinno vativefeaturesofVGG16arethatitfocusesontheconvolutionalfi lterlayerwithastrideof1insteadofmanyhyper-parameters,whichusespaddingandamaximumpoollayerofastri de.CoreLayersUsesfullyconnectedcore layers forthe representationof combinedfeatures derived as single-dimension features. As shown in thefigure,itconsistsofthreelayers:flat,drop-down,anddense.Inthistechnique,thedropoutistoconsideredan dthedenselayer.2.Soft-max classifierIn the soft-max layer, number ofunits depends on different number of categories. A soft-maxlayeroutputsapolynomialdistributionofprobabilityestima tesbasedontheclassificationsperformed.

D. *Implementation*

Following this approach, VGG-16 will be used to classifythe rice types and names. When refining the network model,thelastlayerwascarriedawayonloadandthenafullyconn ected core layer is attached to the output layer. In thissegment the VGG-16 is used to classifies the typesof ricefromtheCNNanalysis

V. Results And Discussion

A. *Training performance*

This is the final prediction and output of this process byusing vgg16 classification model to classifying the rice typesinthegivendataset

Fig.2.Final predictions

VI. Conclusions

The approach proposed a model as VGG-16 for classifyingthe rice images. Methods were evaluated on different datasets.The results when evaluated show that our method is effectiveintermsoflearningparametersaswellasclassification accuracy.Fromtheseresults,itcan beconcludedthatthetypesof rice were specified into different categories. In the existingmodel the CNN find the accuracy of rice images, But in futurewegoingtouseVGG-16toclassifythericeTypes.

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