ISSN 2181-9408

Scientific and technical journal





Sustainable Agriculture

№2(22).2024







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Designer: Dilmurod Akbarov.

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Our address: 39, Kari-Niyaziy str., Tashkent 100000 Uzbekistan , www.sa.tiiame.uz

The journal "Sustainable Agriculture" is registered in the Press Agency of Uzbekistan on the 12th of February in 2018 (license № 0957).

In 2019, the journal is included in the list of recommended scientific publications by the Higher Attestation Commission of the Republic of Uzbekistan.

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PROCESSING OF BLOOD CELL IMAGES HYBRID METHODS OF ACUTE LYMPHOBLASTIC DIAGNOSIS CNN FEATURES

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Abstract

CNN We will consider several image classification algorithms and models for the optimal deep learning model using Convolutional Neural Networks (CNN). Using deep learning of blood cell images, images of healthy blood samples are compared with blood samples of acute lymphoblastic leukemia (blood cancer in children and adults) and the data is compared to obtain an optimal model for early detection of the disease, and Python programming results are automated using the language. We have used CNN network 3 different machine learning hybrid algorithms and methods in the form of DenseNet121, ResNet50 and MobileNet below

Keywords: *CNN; RF; XGBoost; ALL; PCA; hybrid method, DenseNet121, ResNet50 and MobileNet below.*

Introduction. Nowadays, due to the deterioration of ecology, the normal functioning of the blood cells of the human body is disturbed. As a result of this, various diseases are observed in the human organism, which in unfortunate cases increases the number of human deaths and causes the increase of chronic diseases. Doctors treat diseases early detection and accurate diagnosis are considered very bad. This process takes a lot of time and, of course, costs more. Currently, the CNN model of deep learning with the help of artificial intelligence and neural networks is giving effective results. At the same time, early detection of the disease and accurate diagnosis give a very effective result. [1.1]

Scientists of the world are conducting their research on these researches. Including B. Ojokoh and E. Adebisi, "A Review of Question Answering Systems", K. Aurangzeb, Z. A. Muhammad, and A. Hussain, "A Rule-Based Sentiment Classification System for Mobile Social Media Health Review" , K. Aurangzeb, Z. A. Muhammad, and A. Hussain, “A Rule-Based Sentiment Classification System for Mobile Social Media Health Review,” in E. Boiy and M.-F. Moens, "A Machine Learning Approach to Sentiment Analysis in Multilingual Web Texts," E. Boiy and M.-F. Moens, "A Machine Learning Approach to Sentiment Analysis in Multilingual Web Texts," conducted their own research and provided feedback and recommendations.

CNN We will consider several image classification algorithms and models for the optimal deep learning model using Convolutional Neural Networks (CNN). Using deep learning of blood cell images, images of healthy blood samples are compared with blood samples of acute lymphoblastic leukemia (blood cancer in children and adults) and the data is compared to obtain an optimal model for early detection of the disease, and Python programming results are automated using the language. We have used CNN network 3 different machine learning hybrid algorithms and methods in the form of DenseNet121, ResNet50 and MobileNet below.[1.2]

Methodology.

Erythrocytes, leukocytes, thrombocytes are the basis of the benefits of blood, and each cell has its own functions. Red blood cells (45%), plasma (55%), and white blood cells (1%) make up a small amount. An attack on the blood cells is a disease of the blood, which mainly destroys the normal function of the bone marrow. This self-control affects the normal functioning of the control organs of the body, and the most unfortunate thing is that this disease leads to death.

Below are 3 architectures of the CNN methods. A hybrid technique algorithm between MobilNet and machine learning.

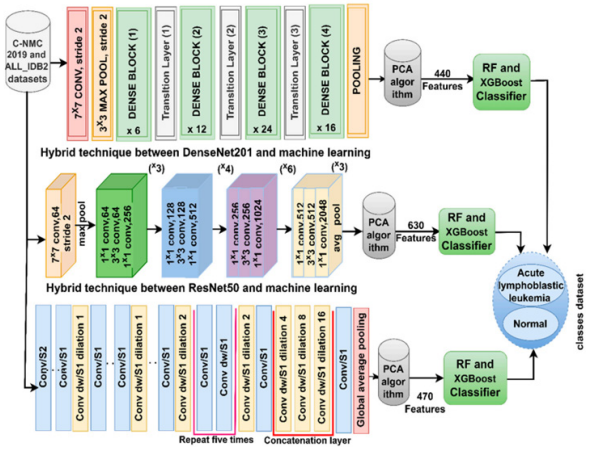


Figure 1. Framework of a hybrid technique between CNN and deep learning for diagnostics EVERYTHING.

As shown in Figure 6, the technique goes through the following algorithm sequence: the first four steps are the same as those of the first technique. Fifth, serial integration

Enter feature vectors into new hybrid vectors as follows: Combine DenseNet121-ResNet50, ResNet50-MobileNet, DenseNet121-MobileNet and DenseNet121-ResNet50-MobileNet vectors into new feature vectors of dimensions 10,106, ×160, ×160, ×101, ×106, 100. 61 × 910, and 10,661 × 1540 for the C-NMC 2019 dataset. Whereas with the ALL-IDB2 dataset, features Stored in feature vectors of 260 × 1070, 260 × 1100, 260 × 910 and 260 × 1540.Sixth, the RF and XGBoost classifiers obtain and classify CNN mixed feature vectors them with high accuracy.

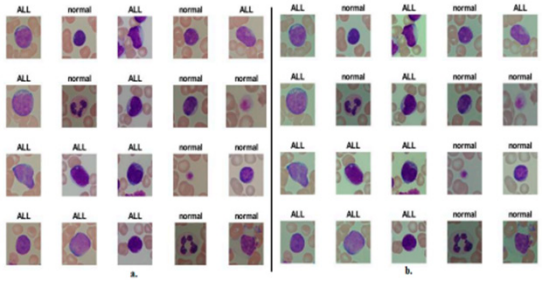


Figure 2. Random selection of images from the C-NMC 2019 dataset
(a). Before improvement. (b)Afterimprovement.

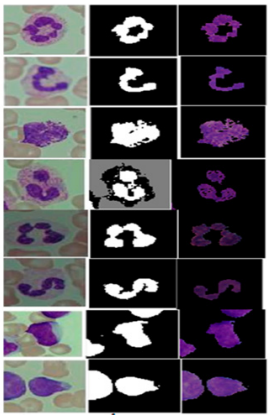


Figure 2. A set of samples from the acute leukemia dataset.
After enhancement. (a) Original images; (b) Segmentation of WBC cells; (c) Region of interest (WBC cells).

Table 1. Splitting the C-NMC 2019 and ALL-IDB2 datasets

Datasets	C- NMC 2019	ALL-IDB2	ALL-IDB2	ALL-IDB2	ALL-IDB2	ALL-IDB2
Phase	80% (80:20)	80% (80:20)	80% (80:20)	80% (80:20)	80% (80:20)	80% (80:20)
Classes-phase	Training(80)	Validati(20)	Testing(20%)	Training(80)	Validati(20)	Testing(20%)
All norma	4654 2169	1164 542	1454 658	83 83	54 54	26 26

Systems Evaluation Metrics and Hyperparameters
AuD=TPRate/FTRate
Accuracy=(TN+TP)/(TN+TP+FN+FP)*100%
Sensitvity=TP/(TP+FN)*100%
Precision=TP/(TP+FP)*100%
Specificity=TN/(TN+FP)*100%
Table 2 shows the hyperparameter options tuning during model training for the two acute leukemia datasets.

Table 2. Adjust hyperparameters options for DenseNet121, ResNet50, and MobileNet models.

Options	DenseNet	ResNet50	MobileNet
Training options	**Adam**	**Adam**	Sgdm
Mini Batch Size	**30**	**12**	7
Max Epochs	**20**	**4**	25
Initial Learn Rote	0.0003	**0.0001**	0.0004
Validation Frequency	50	**3**	40
Execution Environment	4GB GPUNVIDIA	4GB GPUNVIDIA	4GB GPUNVIDIA

Table 3. Data augmentation method of C-NMC 2019 and ALL-IDB2 datasets for acute leukemia

Datasets	C-NMC2019	All IDB2
Phase	Training Datasets	Training Datasets
Classes	All Normal	All Normal
Bef-augmen	4654 2169	83 83
Aft- augmen	9308 8676	1660 1660

Table 4. Results of DenseNet121, ResNet50, and MobileNet models pre-trained on two datasets, C-NMC 2019 and ALL-IDB2, for acute leukemia diagnosis Comparison results

Datasets	Models	Classes	AUC%	*Accuracy*	*Sensitvity*	*Precision*	*Specificity*
C-NMC2019	DenteNet 121	All normal average ration	95.2 94.1 94.65	93.4 83.8 90.3	93.2 84.4 88.8	92.5 85.5 89	83.8 92.9 88.35
	ResNet50	All normal average ration	94.7 95.6 95.15	94.6 85.7 90.8	95.2 85.9 90.55	92.8 88.2 90.5	86.1 94.8 90.53
	MobileNet	All normal average ration	92.9 93.2 93.05	91.8 84.4 89.4	92.2 83.7 87.95	92.6 82.8 87.7	84.2 92.4 88.3
All IDB2	DenteNet 121	All normal average ration	93.9 93.7 93.8	92.3 88.5 90.4	92.4 87.9 90.15	88.9 92 90.45	88.3 92.1 90.2
	ResNet50	All normal average ration	92.8 91.9 92.35	96.2 88.5 92.3	96.1 88.4 92.25	89.3 95.8 92.55	87.7 95.9 91.8
	MobileNet	All normal average ration	93.4 92.7 93.05	92.3 88.5 90.4	92.4 88.1 90.25	88.9 92 90.45	87.7 92.2 89.95

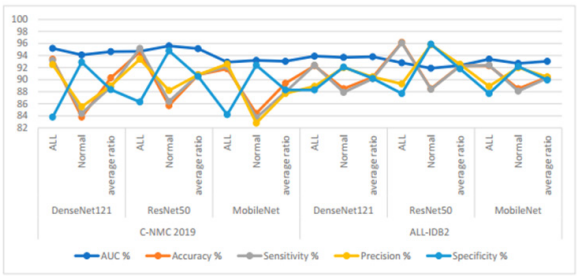


Figure 1 Display of results of CNN models of the C-NMC 2019 and ALL-IDB2 datasets for acute leukemia diagnosis.

Table 5. Results of CNN models based on segmentation WBC of C-NMC 2019 and ALL-IDB2 datasets for acute leukemia diagnosis.

	Models	Classes	AUC%	*Accuracy*	*Sensitvity*	*Precision*	*Specificity*
C-NMC2019	DenteNet 121	All normal average ration	95.7 96.2 95.95	95.8 90.1 94	96.2 90.4 93.3	95.4 90.9 93.15	89.7 95.8 92.75
	ResNet50	All normal average ration	94.1 95.7 94.9	95.7 88.6 93.5	95.8 90.4 93.1	94.8 90.6 92.7	89.4 96.3 92.85
	MobileNet	All normal average ration	95.9 97.1 96.5	96 90.3 94.2	96.1 90.4 93.25	95.5 91.3 93.4	90.2 95.9 93.05
All IDB2	DenteNet 121	All normal average ration	97.1 96.8 96.95	100 88.5 84.2	99.5 87.8 93.65	89.7 100 94.85	88.1 99.7 93.9
	ResNet50	All normal average ration	96.8 97.4 97.1	100 92.3 96.3	99.8 91.8 95.8	92.9 100 96.45	91.9 99.6 95.75
	MobileNet	All normal average ration	96.8 96.5 96.65	96.2 96.2 96.2	96.3 95.9 96.1	95.9 96.4 96.15	96.4 96.3 96.35

The MobilNet algorithm of the proposed CNN model has many advantages: it the convolute makes the production more extensive and diversified, expands through the layers. By re-engineering the number of parameters by combining layers, we achieve a high prediction result. This percentage shows a high result of 96%.

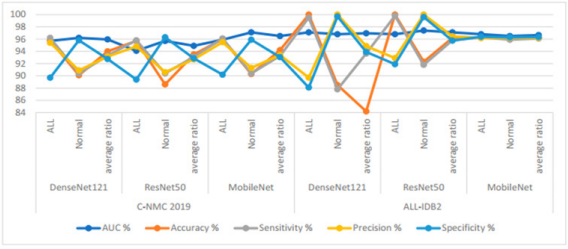


Figure 2 Display of results of CNN models based on WBC segmentation of the C-NMC 2019 and ALL-IDB2 datasets for acute leukemia diagnosis.

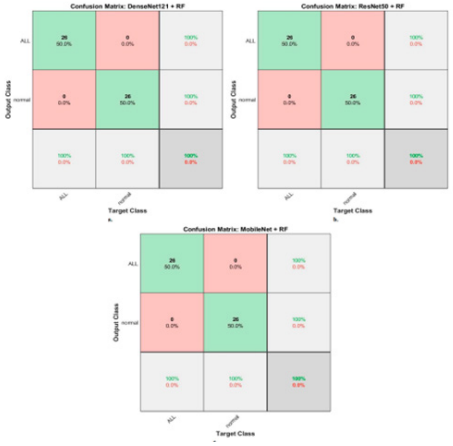


Figure 3. Results of the RF classifier based on the features of the CNN models of the ALL-IDB2 dataset for the diagnosis of acute leukemia confusion matrix of (a) DenseNet121-RF. (b) ResNet50-RF. (c) MobileNet-RF

The segmentation step is a tedious and important process in medical imaging

processing steps. This is the most difficult stage and it must be precise and effective because the following medical image processing steps depend on segmentation accuracy. Segmentation is difficult due to low contrast, reflections, color changes, irregular boundaries.

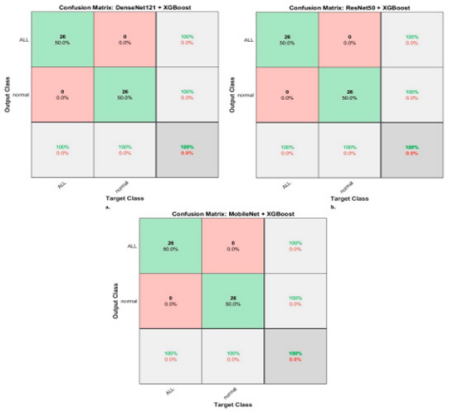


Figure 4. Results of the XGBoost classifier based on the features of the CNN models of the ALLIDB2 dataset for the diagnosis of acute leukemia confusion matrix of (a) DenseNet121-XGBoost. (b) ResNet50-XGBoost. (c) MobileNet-XGBoost Last result

Table 6. Results of all proposed systems for diagnosing images of the NMC 2019 and ALL-IDB2 datasets based on hybrid technologies and fused features

Techniques	Features	Accuracy	All	Normal	Accuracy	All	Normal
pre-trained	DenseNet121	100	93.4	83.8	90.3	92.3	88.5
	ResNet50	100	94.6	85.7	91.8	96.2	88.5
	MobileNet	100	91.8	84.4	89.4	92.3	88.5
Based on active contour	DenseNet121	100	95.8	90.1	94	100	88.5
	ResNet50	100	96	90.3	94.2	100	92.3
	MobileNet	100	95.7	88.6	93.5	96.2	96.2
Hybrid RF	DenseNet121	100	96.1	92.6	95	100	100
	ResNet50	100	96.6	93.4	95.5	100	100
	MobileNet	100	97.1	94.2	96.2	100	100
Hybrid XGBoost	DenseNet121	100	95.8	92.2	94.2	100	100
	ResNet50	100	97.7	90.4	95.4	100	100
	MobileNet	100	96.3	93.2	95.2	100	100
Hybrid RF	DenseNet121ResNet50	100	98.9	95.3	97.7	100	100
	ResNet50-MobileNet	100	98.1	95.7	97.3	100	100
	DenseNet121-MobileNet	100	99.2	97.1	98.5	100	100
	DenseNet121-ResNet50 MobileNet	100	99.3	97.6	98.8	100	100
Hybrid XGBoost	DenseNet121-ResNet50	100	96.7	95.4	96.3	100	100
	ResNet50-MobileNet	100	98	96.8	97.6	100	100
	DenseNet121-MobileNet	100	98.7	96.8	98.1	100	100
	DenseNet121-ResNet50 MobileNet	100	98.6	97.5	98.2	100	100

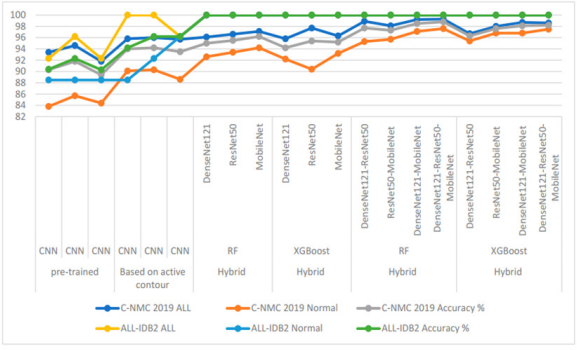


Figure 3. Displaying the results of all systems for the analysis of microscopic blood images for the C-NMC 2019 and ALL-IDB2 datasets acute leukemia at the level of each class.

Currently, the above methods can be programmed in several programming languages, including the Python programming language, which is the most convenient language. Because the ready-made libraries of this programming language have a lot of options and functions, it makes programming the model much more convenient.

Creating a program for the analysis of blood cells and the basis of deep learning with the use of convolutional neural networks (CNN) can be a simple task, given the primary code in the Python language and the use of the TensorFlow and Keras libraries. In this example, the library OpenQ for Image Processing is used. For the application program it is necessary to install all the necessary libraries:

```
Python
import os
import cv2
import numpy as np
import tensorflow as tf
from tensorflow.keras import layers, models
from sklearn.model_selection import train_test_split
# Loading data (assuming you have a dataset of blood cell images)
def load_data(data_dir):
    images = []
    labels = []
```

```
    for label in os.listdir(data_dir):
        label_path = os.path.join(data_dir, label)
        for filename in os.listdir(label_path):
            img_path = os.path.join(label_path, filename)
            img = cv2.imread(img_path)
             img = cv2.resize(img, (128, 128))  # The size of the image cannot be changed
            images.append(img)
             labels.append(int(label))  # Labels are assumed to be integers
    return np.array(images), np.array(labels)
data_directory = "/path/to/your/images"
images, labels = load_data(data_directory)
# Divide data into training and test set
X_train, X_test, y_train, y_test = train_test_split(images, labels, test_size=0.2, random_state=42)
# Create a CNN model
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(128, 128, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(1, activation='sigmoid'))
# Compiling the model
model.compile(optimizer='adam',
              loss='binary_crossentropy',
              metrics=['accuracy'])
# Model training...
model.fit(X_train, y_train, epochs=10, validation_data=(X_test, y_test))
# Accuracy assessment on test data set
test_loss, test_acc = model.evaluate(X_test, y_test)
print(f'Test accuracy: {test_acc}')
```

Please note that this code is a basic example and should be adapted to this task. When applying the program to other tasks, it is required in accordance with the requirements and data must be adapted to the specific task. It also requires a sufficient amount of data for machine learning and correct image labeling.

Conclusions

In conclusion, it can be said that the world will develop as the possibilities of information technology expand, scientists will invent new things as a result of their research work. In this article, 3 types of deep learning CNN models will be compared and the most optimal hybrid algorithm for early detection of leukemia cancer. model was developed and the results proved to work with 98.85% accuracy of prediction.

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