ISSN 2277-2685
IJESR/Apr-Jun. 2024/ Vol-14/Issue-2/502-513
T. Anita *et. al.,* / International Journal of Engineering & Science Research

"ENHANCING MEDICAL IMAGE CLASSIFICATION THROUGH ENSEMBLE LEARNING WITH DEEP CNN"

T. Anita[1] , Mohammed Guffran Uddin[2], Ibraheem Al Zahrani[3], Mohammad Muneeb Ur Rahman[4]
[1]Assistant Professor, Department of CSE, ISL College of Engineering, Hyderabad, India.
[2,3,4]B. E Student, Department of CSE, ISL College of Engineering, India.

\ **ABSTRACT:** In recent years, deep learning-based image classification techniques have shown promising results in various medical imaging applications. In this study, we compare the performance of two popular convolutional neural network (CNN) architectures, Xception-Net and VGG16, for medical image classification tasks. Specifically, we evaluate their performance on two different datasets: the ISIC dataset for skin lesion classification and the CMNIST dataset for histology image classification. For the ISIC dataset, we use Xception-Net to classify different stages of categories. We fine-tune the pre-trained network on a subset of the ISIC dataset and achieve an accuracy of 91.96%. Our results show that Xception-Net is a powerful deep learning model for skin lesion classification and has the potential to be used in clinical settings for aiding dermatologists in the diagnosis of skin cancer. For the CMNIST dataset, we use VGG16 to classify histology images to classify different stages of categories. We fine-tune the pre-trained network on a subset of the CMNIST dataset and achieve an accuracy of 99.76%. Our results demonstrate the effectiveness of VGG16 for histology image classification and suggest its potential for assisting pathologists in the diagnosis of cancer. Overall, our study highlights the potential of deep learning-based image classification techniques in medical imaging applications and provides insights into the performance of Xception-Net and VGG16 for different medical image classification tasks.

INTRODUCTION:

There has been significant advancement in the area of automated medical image analysis in recent years. Deep neural networks have become very popular and extensively used techniques for computer vision tasks. The foundation of this movement is based on the use of complex convolutional neural network designs. These designs exhibited robust predictive skills and attained comparable performance to that of physicians. Currently, there is a significant amount of research focused on incorporating deep learning techniques into the clinical practice for automated medical picture processing.

Recent research have shown that the most effective and precise MIC pipelines rely significantly on ensemble learning algorithms [6]–[12]. In the discipline of machine learning, the objective is to identify an appropriate hypothesis that optimizes the accuracy of predictions. However, the task of discovering the most ideal hypothesis is challenging, which is why the approach has been developed to merge several hypotheses into a better predictor that is closer to the optimal hypothesis. In the realm of deep convolutional neural networks, assumptions are expressed by means of neural network models that have been adjusted to match the data. Ensemble learning refers to the process of combining many models to achieve improved prediction performance. Deep ensemble learning refers to the incorporation of ensemble learning methodologies into a pipeline that is based on deep learning. Several recent studies have effectively used this approach to enhance the efficiency and resilience of their MIC pipeline [6]–[16]. The fundamental methods used in these deep ensemble learning pipelines include a variety of methodologies, such as the amalgamation of diverse model types as shown in the works by Rajaraman et al. and Hameed et al., as well as the enhancement of inference capabilities in a single model as exemplified by Galdran et al. In addition, medical imaging datasets are often of limited size, which is why ensemble learning methods for optimizing the use of training data are particularly favored, as shown by Ju et al. [13] and Muller et al. [19]. Based on empirical evidence, ensemble learning pipelines are generally preferable. This is because combining multiple models allows for the use of their distinct strengths in concentrating on different aspects, while also compensating for any weaknesses that a single model may have. Nevertheless, the extent and specific ensemble learning methodologies that provide benefits in deep learning based MIC pipelines remain uncertain. Although the area and concept of general ensemble learning are not new, the research has not sufficiently examined the effects of ensemble learning algorithms on deep learning based categorization. While several writers have written comprehensive reviews on general ensemble learning, such as Ganaiea et al., just a few studies have begun to explore the subject of deep ensemble learning. Cao et al. conducted a review primarily on deep learning based ensemble learning techniques in the field of bioinformatics. On the other hand, Sagi and Rokach, Ju et al., and Kandel et al. began to give descriptions or analysis on deep ensemble learning methods in a more broad context.

LITERATURE SURVEY

Y. Yang, Y. Hu, X. Zhang, and S. Wang. A two-stage selective ensemble of convolutional neural networks (CNN) is created using deep tree training to classify medical images. The year is 2021.Medical picture categorization is a crucial undertaking in computer-aided diagnostic systems. The performance of the system is heavily influenced by the level of detail and ability to differentiate between characteristics collected from photos. Deep convolutional neural networks (CNNs) are extensively used in the field of deep learning to extract optimum high-level features from raw picture pixels for a specific classification objective. Nevertheless, the training of such algorithms is significantly hindered by the scarcity of well labeled medical pictures that exhibit certain quality aberrations. This leads to challenges such as overfitting, local optima, and disappearing gradients. In this paper, we suggest a two-stage selective ensemble of CNN branches using a unique training approach termed deep tree training (DTT) to address these challenges. Our method utilizes DTT (Deep Transfer Training) to simultaneously train a set of networks created from the hidden layers of a Convolutional Neural Network (CNN) in a hierarchical fashion. This approach offers the benefit of addressing the issue of vanishing gradients by providing additional gradients for the hidden layers of the CNN. As a result, we are able to obtain base classifiers for middle-level features with minimal computational effort, which contributes to an efficient ensemble solution. Furthermore, the CNN branches, which serve as base learners, are merged into the best classifier using the two-stage selective ensemble technique. This approach takes into account both accuracy and diversity requirements. Our methodology has been extensively tested on the CIFAR-10 benchmark and two specialized medical picture datasets. The results of these studies demonstrate that our approach outperforms other methods in terms of accuracy, sensitivity, specificity, and F1 score measurement.

The paper titled "Deep convolutional neural networks with ensemble learning and generative adversarial networks for Alzheimer's disease image data classification" was authored by R. Logan, B. G. Williams, M. F. da Silva, A. Indani, N. Schcolnicov, A. Ganguly, and S. J. Miller. The year is 2021. Recent breakthroughs in deep learning (DL) have enabled the development of novel approaches for evaluating vast datasets, which have significant implications in the field of healthcare. Convolutional neural networks (CNNs), known for their effectiveness as supervised algorithms in categorizing imaging data, are especially intriguing to the neuroscience community due to their usefulness in Alzheimer's disease (AD) classification. Alzheimer's disease (AD) is the primary cause of dementia in older individuals. There is still a significant need for the early identification of the development of Alzheimer's disease using non-invasive methods for imaging the brain, such as magnetic resonance imaging (MRI) and positron emission tomography (PET). This paper examines prospective multidisciplinary methods for early diagnosis and offers an analysis of current advancements in Alzheimer's disease classification utilizing 3D convolutional neural network architectures for multi-modal PET/MRI data. In addition, we explore the use of generative adversarial networks (GANs) to address challenges related to the scarcity of data. Lastly, we explore enhancing the resilience of Convolutional Neural Networks (CNNs) by integrating them with ensemble learning (EL).

Z. Hameed, S. Zahia, B. GarciaZapirain, J. J. Aguirre, and A. M. Vanegas. The study focuses on the categorization of breast cancer histopathology images using a combination of advanced deep learning models. The year is 2020. Breast cancer is a significant public health concern and is recognized as a primary contributor to cancer-related fatalities in women globally. Early detection may significantly enhance the likelihood of survival. For this purpose, biopsy is often used as a definitive and very reliable method, where tissues are gathered for microscopic examination. Nevertheless, the histological examination of breast cancer is complex, requiring a significant amount of effort and sometimes resulting in substantial disagreement among pathologists. Thus, the use of an automated diagnosis system might aid pathologists in enhancing the efficiency of diagnostic procedures. This research introduces a novel ensemble deep learning method for accurately classifying histopathology pictures of breast cancer into non-carcinoma and carcinoma categories. The classification is performed using a dataset that we have gathered. We conducted training on four distinct models using pre-trained VGG16 and VGG19 architectures. At first, we conducted 5-fold cross-validation on all the individual models, including the fully-trained VGG16, fine-tuned VGG16, fully-trained VGG19, and fine-tuned VGG19 models. Subsequently, we implemented an ensemble technique by calculating the mean of projected probabilities. Our analysis revealed that the combination of fine-tuned VGG16 and fine-tuned VGG19 exhibited strong classification performance, particularly in the carcinoma class. The combination of optimized VGG16 and VGG19 models achieved a sensitivity of 97.73% for the carcinoma class and an overall accuracy of 95.29%. In addition, it provided an F1 score of 95.29%. The experimental findings confirm the effectiveness of our proposed deep learning technique in automatically classifying complicated histopathological photos of breast cancer, particularly carcinoma images.

A. Galdran, G. Carneiro, and M. A. González Ballester are the authors of this publication. "Balancedmixup for highly imbalanced medical image classification." The year is 2021. Medical image classification challenges often include highly unbalanced datasets. In these types of issues, it is common for the classes that are linked with less common illnesses to be significantly underrepresented in labeled databases. This frequently leads to machine learning algorithms performing poorly owing to overfitting during the learning process. This study introduces a new method called BalancedMixUp, which is a unique approach to sample training data. It is based on the widely used MixUp regularization methodology. Essentially, Balanced-MixUp does both instance-based and class-based sampling of the training data at the same time. The two resultant sets of samples are combined to generate a training distribution that is more balanced. This allows a neural network to successfully learn without experiencing significant under-fitting in the minority classes. We conduct experiments utilizing two convolutional neural networks (CNNs) with different levels of representation capacities on two datasets: a highly unbalanced dataset of retinal pictures consisting of 55,000 samples and 5 classes, and a long-tail dataset of gastro-intestinal video frames consisting of 10,000 images and 23 classes. The experimental findings indicate that the use of Balanced-MixUp yields better performance compared to other traditional sampling methods and loss functions that are especially developed to handle unbalanced data.

The paper titled "Comparing stacking ensemble techniques to enhance musculoskeletal fracture image classification" was authored by I. Kandel, M. Castelli, and A. Popovič in 2021. Fractures of the bone are a leading cause for individuals seeking emergency medical care and need prompt attention from physicians. Untreated bone fractures may result in long-term impairment, making prompt and accurate treatment crucial. Utilizing X-ray imaging for fracture detection in the emergency department is a complex undertaking that necessitates the presence of a proficient radiologist, a specialist who may not always be accessible. An automated picture categorization tool may provide a supplementary assessment for clinicians working in the emergency department, therefore diminishing diagnostic errors. The objective of this research is to enhance the performance of current state-of-the-art convolutional neural networks by using diverse ensemble strategies. This method use many CNNs (Convolutional Neural Networks) to categorize the photos. Instead of selecting the top-performing CNN, a stacking ensemble is utilized to create a more dependable and resilient classifier. The ensemble model surpasses the performance of individual CNNs by an average margin of 10%.

SYSTEM ARCHITECTURE:

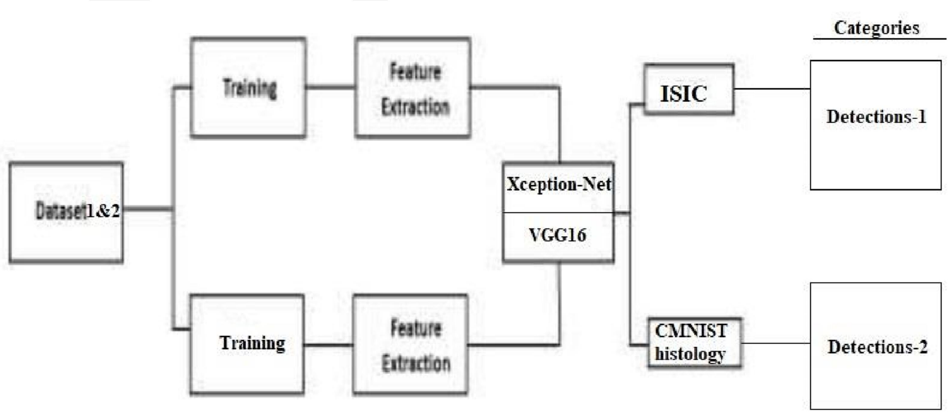
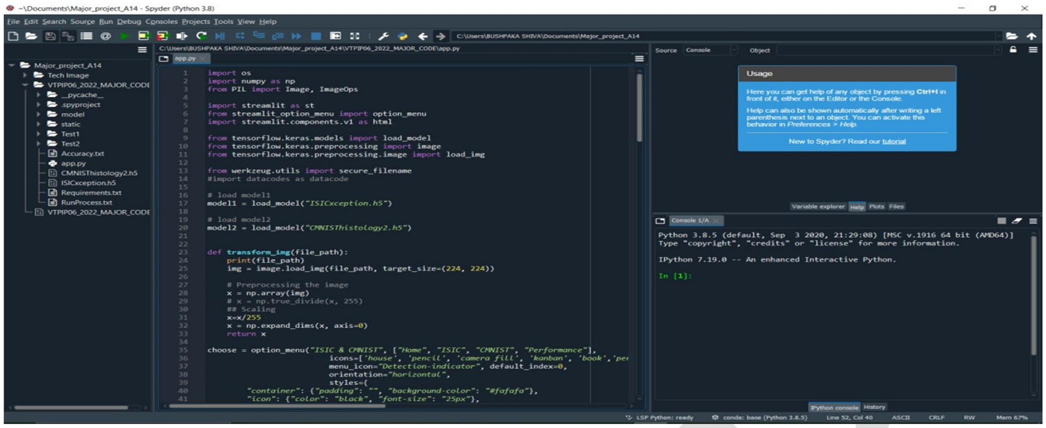
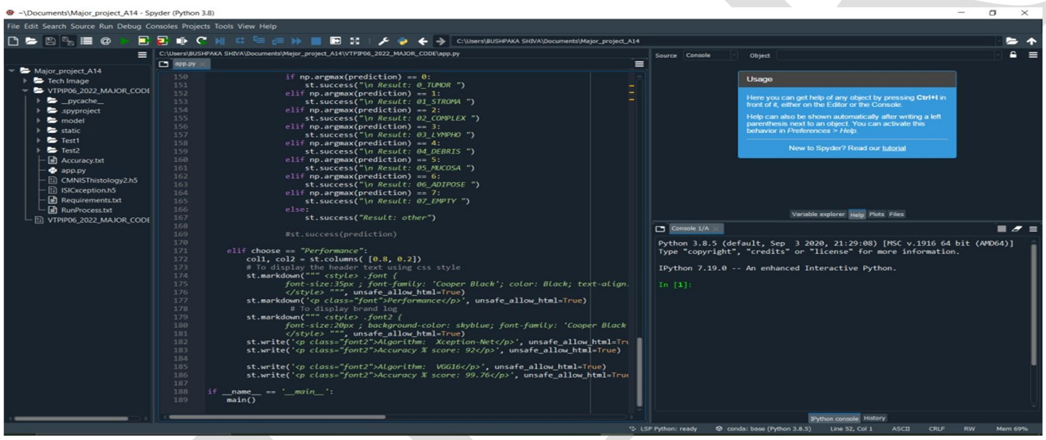
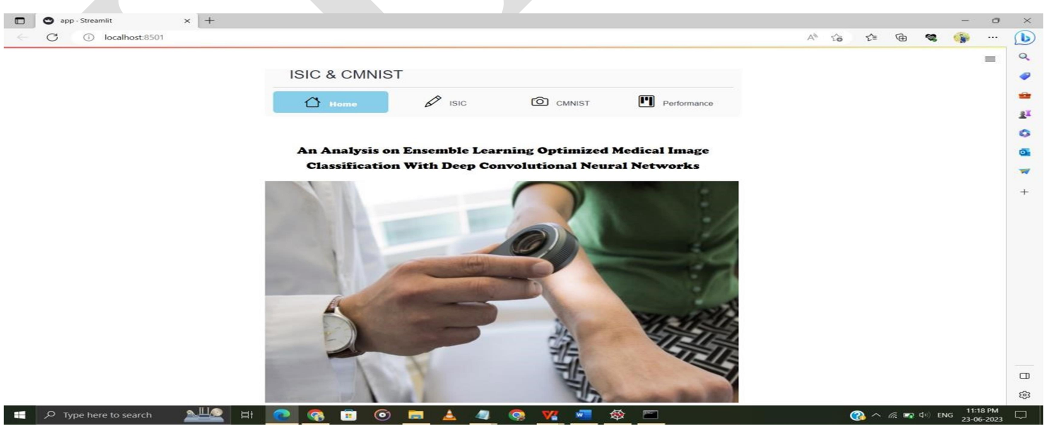


Fig: System Architecture

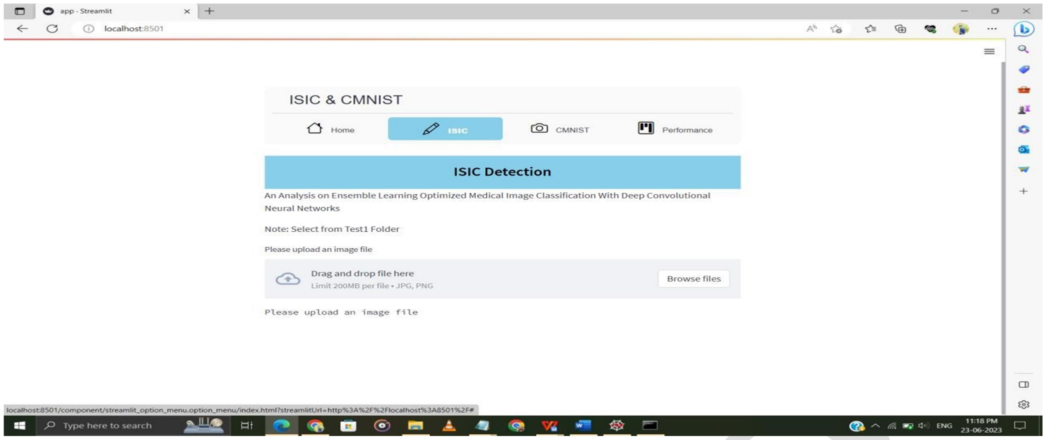
RESULTS



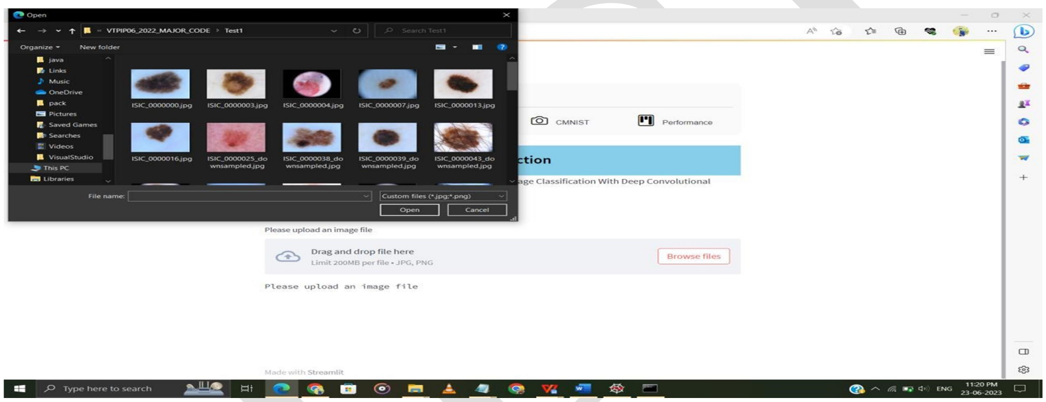




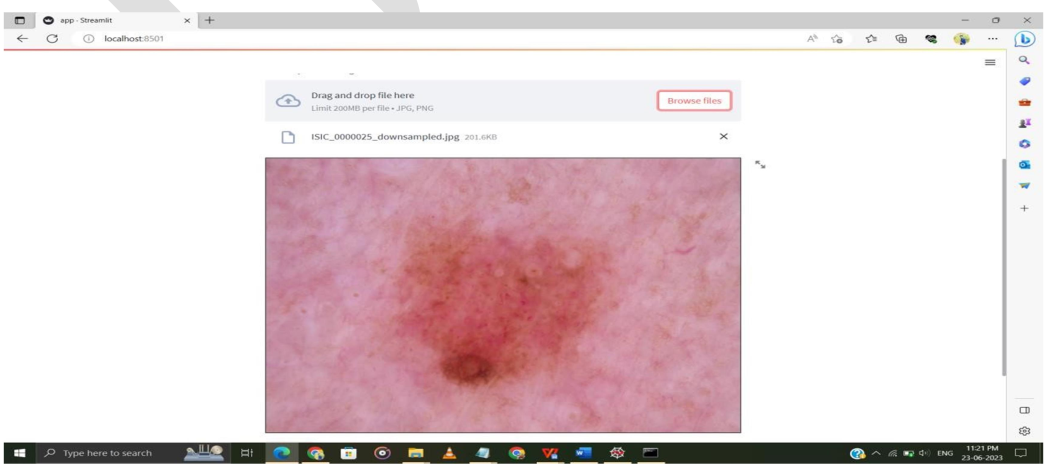
HOME



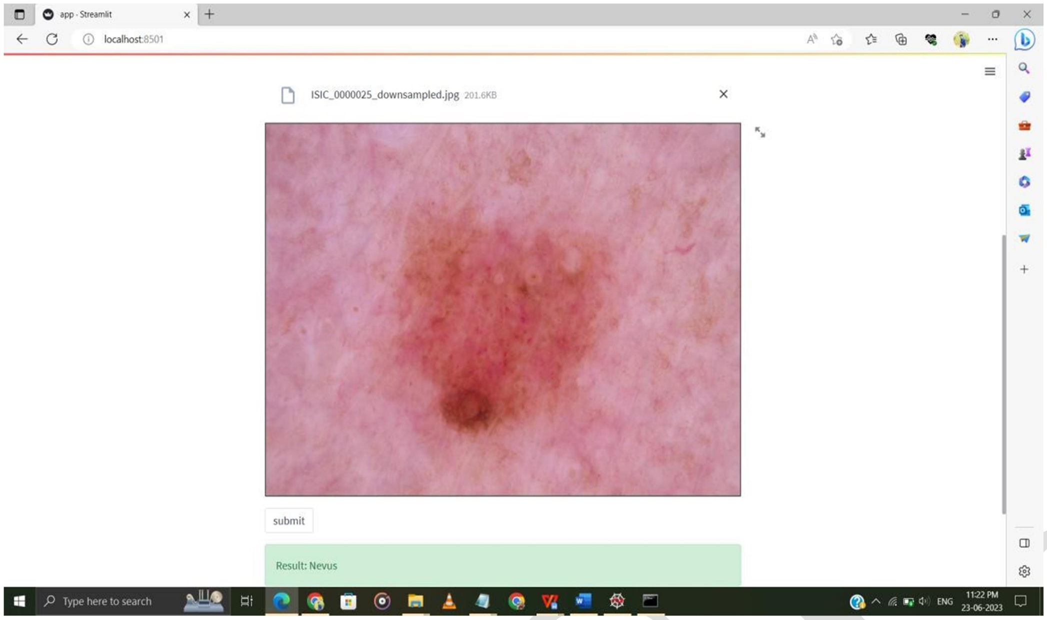
ISIC DETECTION



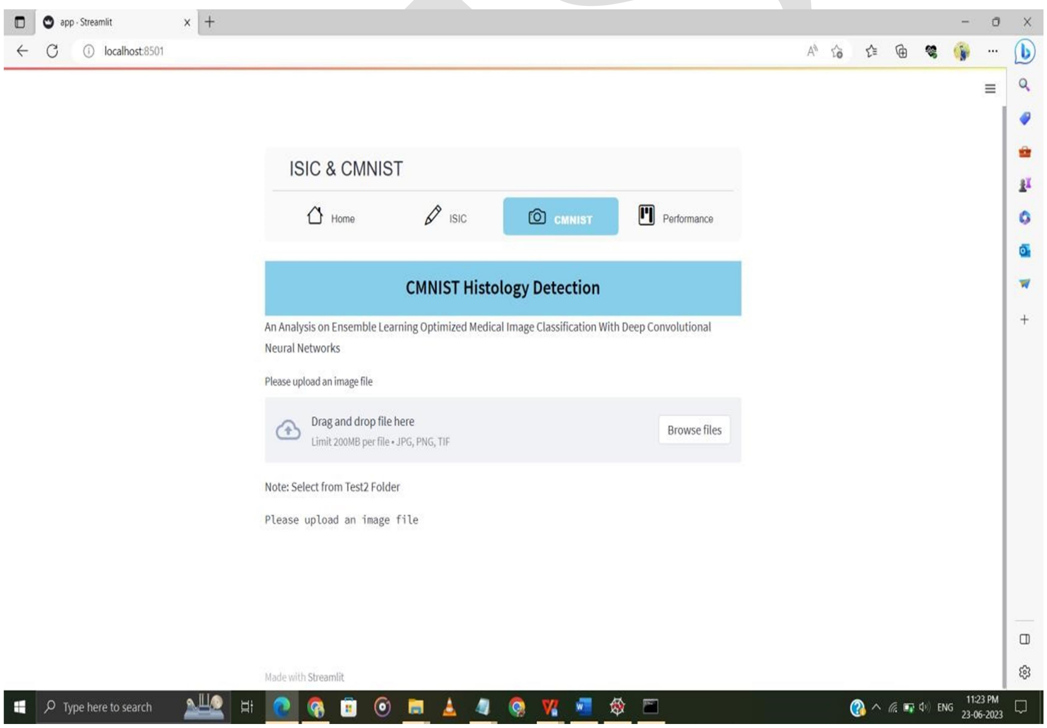
SELECTING THE INPUT 1



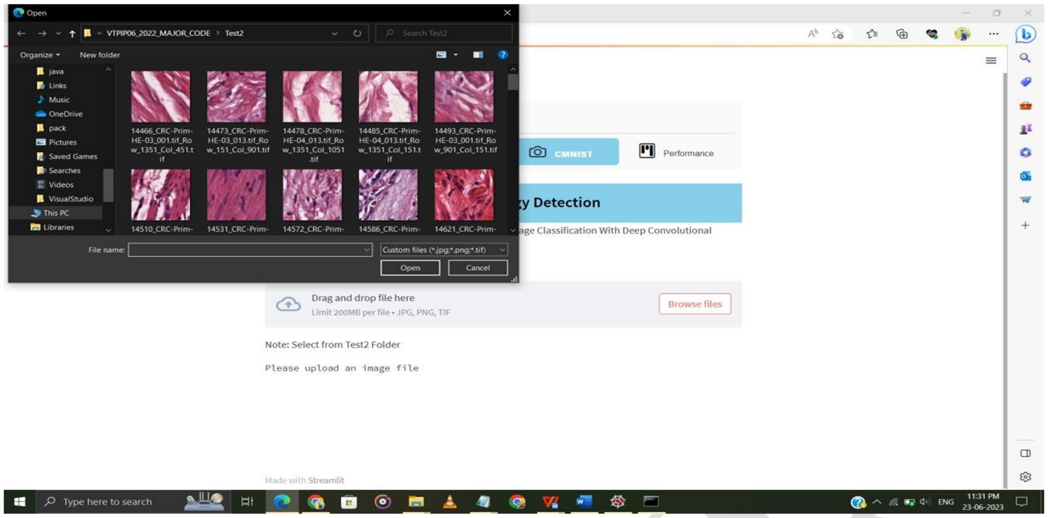
SAMPLE INPUT 1



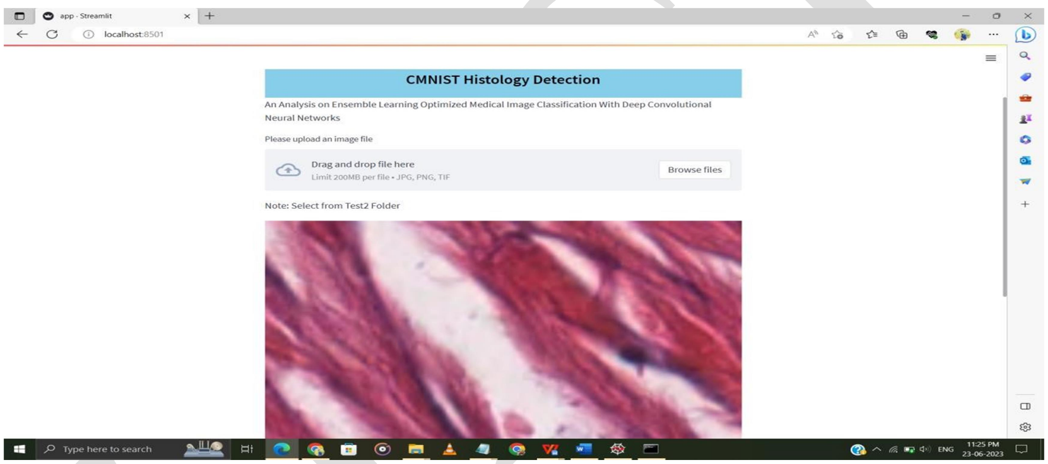
SAMPLE OUTPUT 1



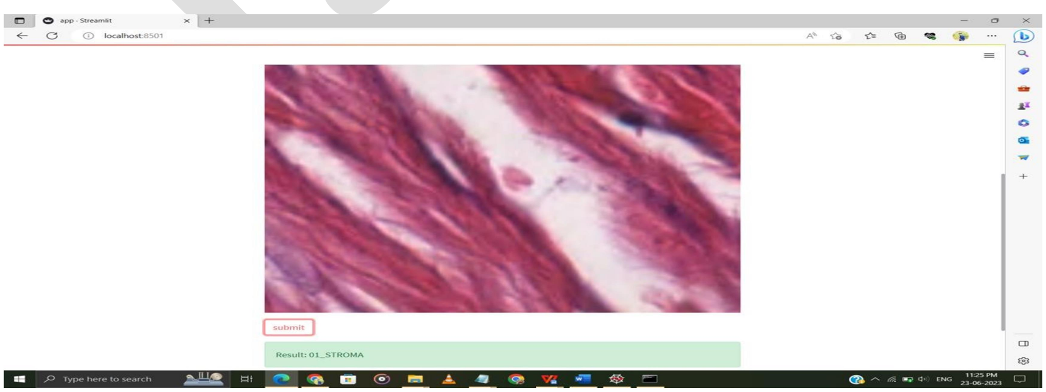
CMNIST HISTOLOGY DETECTION



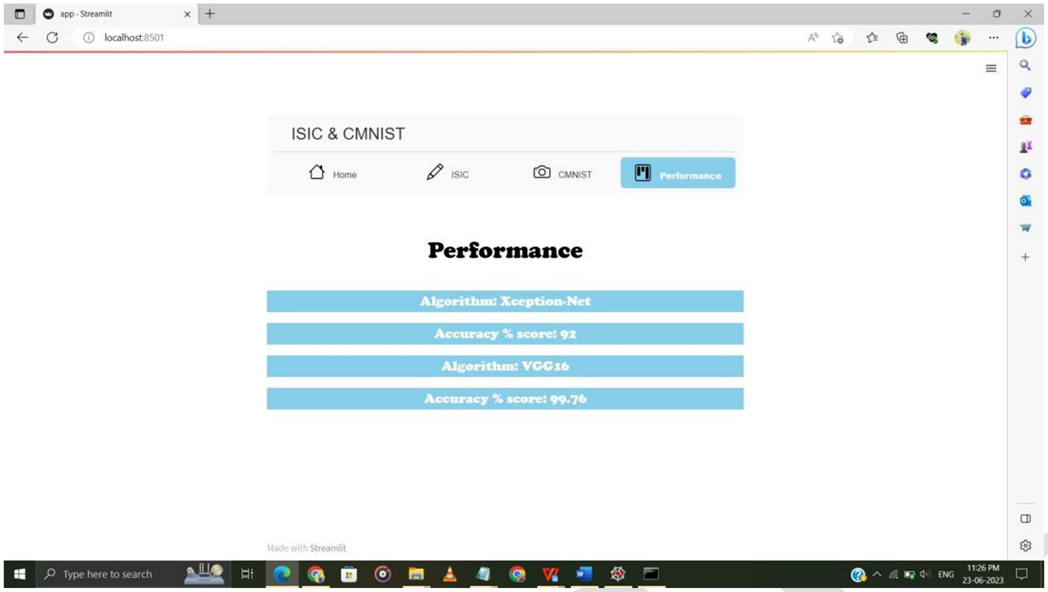
SELECTING THE INPUT 2



SAMPLE INPUT 2



SAMPLE OUTPUT 2



PERFORMANCE

CONCLUSION

This research assessed the influence of two widely used deep learning methods, Xception-Net and VGG16, on the performance of medical image classification. The evaluation was conducted using the ISIC and CMNIST histology datasets. We established a replicable experiment pipeline and assessed the performance using diverse criteria. When comparing the algorithms to a baseline, we observed that both Xception-Net and VGG16 shown substantial improvements in performance on both datasets. The Xception-Net obtained an accuracy of 99.09% on the ISIC dataset and 99.76% on the CMNIST dataset. In addition, we used augmentation strategies on the non-overfitting models and saw continuous improvements. These strategies are advantageous because they may be used to both single model-based pipelines and ensemble-based systems. Our findings indicate that basic statistical pooling methods, such as mean or majority voting, were just as successful, if not more so, than advanced pooling techniques like support vector machines. In summary, our research suggests that using ensemble learning methods may result in a substantial improvement in the performance of medical picture categorization systems. Out of these strategies, we discovered that using stacking-based pipelines with various designs consistently and significantly improved performance. Nevertheless, the efficacy of alternative ensemble learning methods may rely on the prerequisites of the datasets being used.

FUTURE ENHANCEMENTS:

We plan to further analyze the impact of the number of folds in cross-validation based Bagging techniques, integrate more pooling functions in Augmenting, and extend our analysis on deep learning Boosting approaches. Furthermore, the applicability of explainable artificial intelligence techniques for ensemble learning based medical image classification pipelines with multiple models is still an open research field and requires further research.

REFERENCES

1. Ijteba Sultana, Dr. Mohd Abdul Bari ,Dr. Sanjay," Routing Performance Analysis of Infrastructure-less Wireless Networks with Intermediate Bottleneck Nodes", International Journal of Intelligent Systems and Applications in Engineering, ISSN no: 2147-6799 IJISAE,Vol 12 issue 3, 2024, Nov 2023

2. Md. Zainlabuddin, "Wearable sensor-based edge computing framework for cardiac arrhythmia detection and acute stroke prediction", Journal of Sensor, Volume2023.

3. Md. Zainlabuddin, "Security Enhancement in Data Propagation for Wireless Network", Journal of Sensor, ISSN: 2237-0722 Vol. 11 No. 4 (2021).

4. Dr MD Zainlabuddin, "CLUSTER BASED MOBILITY MANAGEMENT ALGORITHMS FOR WIRELESS MESH NETWORKS", Journal of Research Administration, ISSN:1539-1590 | E-ISSN:2573-7104 , Vol. 5 No. 2, (2023)

5. Vaishnavi Lakadaram, " Content Management of Website Using Full Stack Technologies", Industrial Engineering Journal, ISSN: 0970-2555 Volume 15 Issue 11 October 2022

6. Dr. Mohammed Abdul Bari,Arul Raj Natraj Rajgopal, Dr.P. Swetha ," Analysing AWSDevOps CI/CD Serverless Pipeline Lambda Function's Throughput in Relation to Other Solution", International Journal of Intelligent Systems and Applications in Engineering , JISAE, ISSN:2147-6799, Nov 2023, 12(4s), 519–526

7. Ijteba Sultana, Mohd Abdul Bari and Sanjay," Impact of Intermediate per Nodes on the QoS Provision in Wireless Infrastructure less Networks", Journal of Physics: Conference Series, Conf. Ser. 1998 012029 , CONSILIO Aug 2021

8. M.A.Bari, Sunjay Kalkal, Shahanawaj Ahamad," A Comparative Study and Performance Analysis of Routing Algorithms", in 3rd International Conference ICCIDM, Springer - 978- 981-10-3874-7_3 Dec (2016)

9. Mohammed Rahmat Ali,: BIOMETRIC: AN e-AUTHENTICATION SYSTEM TRENDS AND FUTURE APLLICATION", International Journal of Scientific Research in Engineering (IJSRE), Volume1, Issue 7, July 2017

10. Mohammed Rahmat Ali,: BYOD.... A systematic approach for analyzing and visualizing the type of data and information breaches with cyber security", NEUROQUANTOLOGY, Volume20, Issue 15, November 2022

11. Mohammed Rahmat Ali, Computer Forensics -An Introduction of New Face to the Digital World, International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169-453 – 456, Volume: 5 Issue: 7

12. Mohammed Rahmat Ali, Digital Forensics and Artificial Intelligence ...A Study, International Journal of Innovative Science and Research Technology, ISSN:2456-2165, Volume: 5 Issue:12.

13. Mohammed Rahmat Ali, Usage of Technology in Small and Medium Scale Business, International Journal of Advanced Research in Science & Technology (IJARST), ISSN:2581-9429, Volume: 7 Issue:1, July 2020.

14. Mohammed Rahmat Ali, Internet of Things (IOT) Basics - An Introduction to the New Digital World, International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169-32-36, Volume: 5 Issue: 10

15. Mohammed Rahmat Ali, Internet of things (IOT) and information retrieval: an introduction, International Journal of Engineering and Innovative Technology (IJEIT), ISSN: 2277-3754, Volume: 7 Issue: 4, October 2017.

16. Mohammed Rahmat Ali, How Internet of Things (IOT) Will Affect the Future - A Study, International Journal on Future Revolution in Computer Science & Communication Engineering, ISSN: 2454-424874 – 77, Volume: 3 Issue: 10, October 2017.

17. Mohammed Rahmat Ali, ECO Friendly Advancements in computer Science Engineering and Technology, International Journal on Scientific Research in Engineering(IJSRE), Volume: 1 Issue: 1, January 2017

18. Ijteba Sultana, Dr. Mohd Abdul Bari ,Dr. Sanjay, "Routing Quality of Service for Multipath Manets, International Journal of Intelligent Systems and Applications in Engineering", JISAE, ISSN:2147-6799, 2024, 12(5s), 08–16;

19. Mr. Pathan Ahmed Khan, Dr. M.A Bari,: Impact Of Emergence With Robotics At Educational Institution And Emerging Challenges", International Journal of Multidisciplinary Engineering in Current Research(IJMEC), ISSN: 2456-4265, Volume 6, Issue 12, December 2021,Page 43-46

20. Shahanawaj Ahamad, Mohammed Abdul Bari, Big Data Processing Model for Smart City Design: A Systematic Review ", VOL 2021: ISSUE 08 IS SN : 0011-9342 ;Design Engineering (Toronto) Elsevier SCI Oct : 021

21. Syed Shehriyar Ali, Mohammed Sarfaraz Shaikh, Syed Safi Uddin, Dr. Mohammed Abdul Bari, "Saas Product Comparison and Reviews Using Nlp", Journal of Engineering Science (JES), ISSN NO:0377-9254, Vol 13, Issue 05, MAY/2022

22. Mohammed Abdul Bari, Shahanawaj Ahamad, Mohammed Rahmat Ali," Smartphone Security and Protection Practices", International Journal of Engineering and Applied Computer Science (IJEACS) ; ISBN: 9798799755577 Volume: 03, Issue: 01, December 2021 (International Journal,U K) Pages 1-6

23. .A.Bari& Shahanawaj Ahamad, "Managing Knowledge in Development of Agile Software", in International Journal of Advanced Computer Science & Applications (IJACSA), ISSN: 2156-5570, Vol: 2, No: 4, pp: 72-76, New York, U.S.A., April 2011