IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134188

Brain Tumor Detection and Diagnosis using YOLO (V8) in Deep Learning

Dr. Seedha Devi V[1], Alangaram S[2], Poovaraghan R.J[3], Arockia Kelvin S[4], Dinesh T[5]

Prof, Department of IT, Jaya Engineering College, Chennai, India[1]

Asst.Prof, Department of IT, Jaya Engineering College, Chennai, India[2,3]

Student, Department of IT, Jaya Engineering College, Chennai, India[4,5]

Abstract: The advent of advanced healthcare software systems presents a promising avenue for revolutionizing the early detection and management of brain tumors, a critical aspect of modern healthcare. This project delves into the development of such a system, leveraging cutting-edge technologies to enhance the efficiency and effectiveness of brain tumor diagnosis and patient care. At its core, the system harnesses the power of the YOLO (V8) algorithm to enable precise detection of tumors from MRI scans, providing clinicians with invaluable insights into patient health. Moreover, the software facilitates seamless communication between patients and healthcare facilities, streamlining processes such as appointment scheduling and confirmation in real-time. Built on a robust software architecture comprising React for the frontend and Python (Flask) and .Net (6.0) for backend functionalities, the system offers an intuitive user interface that empowers users to upload MRI scans, schedule appointments, and visualize tumor detection results with ease. Integration with Firebase ensures secure user authentication, enhancing the privacy and security of patient data. By amalgamating these technologies, this project endeavors to create a user-friendly, efficient, and integrated healthcare solution that prioritizes timely diagnosis and improved patient care. The overarching goal is to address the pressing need for early detection and management of brain tumors, ultimately contributing to better health outcomes for patients worldwide.

Keywords: Brain tumor detection, MRI scan, DL, Patient engagement, Appointment scheduling, User authentication.

I. INTRODUCTION

Artificial intelligence (AI) permeates modern technology, embodying the emulation of human intelligence through software-coded heuristics. The year 2022 marked a significant milestone as AI gained mainstream recognition, propelled by ubiquitous applications like OpenAI's DALL-E and ChatGPT, which captivated public imagination. Fundamentally, AI is characterized by its capacity to rationalize and execute actions to achieve specific goals, with machine learning (ML) constituting a pivotal subset. ML empowers computer programs to learn and adapt from new data autonomously, without human intervention, with deep learning techniques facilitating automatic learning from vast datasets comprising unstructured data such as text, images, or video. In the realm of healthcare, early detection and effective management of diseases play a pivotal role in improving patient outcomes and reducing mortality rates. Brain tumors, in particular, present significant challenges due to their complexity and potential for rapid progression. However, advancements in medical imaging technology, coupled with the advent of artificial intelligence (AI) and machine learning (ML) algorithms, offer promising solutions for enhancing the diagnostic process and optimizing patient care.

Our project aims to harness the power of AI and ML to develop a sophisticated healthcare software system dedicated to the early detection and management of brain tumors. By leveraging state-of-the-art deep learning techniques and advanced image analysis algorithms, our system seeks to revolutionize the way brain tumors are diagnosed and treated. Through seamless integration with medical imaging technologies such as MRI scans, our platform enables healthcare providers to accurately identify and characterize tumors with unprecedented speed and accuracy.

Our primary objective is to develop an AI-powered tumor detection module capable of accurately identifying and characterizing brain tumors from MRI scans. This involves leveraging advanced deep learning models such as YOLO (You Only Look Once) to achieve high levels of sensitivity and specificity in tumor detection, facilitating early diagnosis and intervention. Additionally, our system aims to streamline healthcare delivery through seamless communication between patients and healthcare providers, efficient appointment management functionalities, and a user-friendly interface. Data security and patient privacy are prioritized through robust security measures and encryption protocols. Continuous improvement based on user feedback and emerging technological advancements is integral to our commitment to excellence in healthcare technology.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134188

II. YOLO TECHNOLOGY

In our journal paper, we present a novel application of advanced technology in the healthcare domain, specifically focusing on the integration of the YOLO v8 model for image processing alongside sophisticated appointment scheduling functionalities. The YOLO v8 model stands as a pinnacle in real-time object detection algorithms, renowned for its speed, accuracy, and versatility. With its inception in 2015 and subsequent iterations, YOLO v8 has emerged as a leading solution for various image processing tasks, including medical imaging.

Our project harnesses the power of YOLO v8 to facilitate precise and efficient detection of brain tumors from MRI scans, underscoring its potential to revolutionize diagnostic processes in healthcare. By leveraging the capabilities of this state-of-the-art model, we aim to enhance early detection and management of brain tumors, thereby improving patient outcomes and healthcare efficiency.

Furthermore, our project extends beyond image processing to encompass appointment scheduling functionalities, essential for seamless patient management within healthcare facilities. Leveraging modern technologies such as .Net (6.0) for backend development, we integrate robust appointment scheduling mechanisms into our system, enabling real-time interaction between patients and healthcare providers. The synergy between the YOLO v8 model for image processing and advanced appointment scheduling functionalities underscores our commitment to developing a comprehensive healthcare solution that prioritizes both diagnostic accuracy and patient care management. Through this innovative integration of technology, we aim to address critical challenges in healthcare delivery, ultimately contributing to improved patient outcomes and enhanced healthcare efficiency.

III. LITERATURE REVIEW

In their study, Dr. R. Ramya and colleagues present a novel approach to brain tumor detection using deep learning technologies. By integrating particle swarm optimization (PSO) with the YOLOv7 deep learning system, the researchers aim to improve the accuracy and efficiency of automated brain tumor diagnosis in MRI scans. The PSO technique is utilized for precise tumor region-of-interest (ROI) segmentation, leveraging the BRaTS21 dataset as a benchmark. Subsequently, the segmented ROI is input into the YOLOv7 architecture for accurate tumor localization and classification. The integration of PSO and YOLOv7 results in enhanced detection performance, validated through training on the PSO-segmented BRATS21 data. Evaluation metrics such as precision, recall, mean average precision (mAP), and F1 score demonstrate the superior accuracy of 93% and processing speed of the proposed system compared to existing methodologies. The PSO-YOLOv7 framework shows significant improvement over previous models, offering promising clinical applications for earlier diagnoses, informed treatment decisions, and improved patient outcomes.

Tejas Shelatkar and co-authors propose a transfer learning approach for the early detection of malignant brain tumors using MRI scans. Their study utilizes the YOLOv5 object detection framework, known for its lightweight computational architecture, to identify and classify tumors, particularly glioblastoma. By leveraging the Brats 2021 dataset, the model achieves a precision of 88 percent. The pre-processed data undergoes testing and training, demonstrating successful detection of brain tumors across the dataset. Their research underscores the potential of deep learning-based systems in aiding neurologists and radiologists to detect brain tumors early, contributing to improved patient outcomes.

S. Beatrice and Clive Jude D'Costa address the critical issue of brain tumor detection in their study. They highlight the complexity of manual screening due to the intricate structure of the brain and the varied characteristics of tumors. Leveraging advancements in computer science, the authors propose an automatic detection and classification solution using machine learning techniques. Through comprehensive experiments on selected datasets, their proposed model demonstrates competitive results, offering promising potential for improving accuracy in brain tumor diagnosis and classification.

In their study published in the Egyptian Journal of Radiology and Nuclear Medicine, Ghada Saad, Ali Suliman, Luna Bitar, and Shady Bshara introduce a hybrid algorithm for brain tumor detection from MRI images. They highlight the significance of computer-aided diagnosis systems (CADs) in improving clinicians' detection rates of positive cases. Their hybrid algorithm achieves an impressive detection accuracy of 96.6% and includes a user-friendly computer application for tumor localization. The authors suggest further improvements through the exploration of different segmentation techniques, additional feature extraction methods, or alternative classifiers.

In their research published in Cognitive Computation, Francesco Prinzi, Marco Insalaco, Alessia Orlando, Salvatore Gaglio, and Salvatore Vitabile address the critical challenge of accurately detecting and classifying brain tumors at early

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134188

stages. Their proposed solution involves an enhanced model based on Convolutional Neural Networks (CNN) with ResNet50 and U-Net. Leveraging the TCGA-LGG and TCIA datasets, consisting of 120 patients, their model effectively detects and classifies tumor or no-tumor images, with U-Net employed for precise tumor segmentation.

Evaluation metrics such as accuracy, intersection over union, dice similarity coefficient, and similarity index demonstrate the model's superior performance. Particularly, the fine-tuned ResNet50 model achieves an intersection over union of 0.91 and a dice similarity coefficient of 0.95. However, the integration of U-Net with ResNet50 surpasses all other models, accurately classifying and segmenting tumor regions.

IV. PROPOSED METHODOLOGY

The proposed healthcare software system aims to address critical challenges in the early detection and management of brain tumors through the integration of advanced technologies and user-centric design. At its core, the system consists of three main modules: MRI Scan Analysis, Appointment Management, and Authentication and Communication.

The MRI Scan Analysis module utilizes state-of-the-art deep learning techniques, specifically the YOLOv8 model, to analyze MRI scans uploaded by users. This module employs convolutional neural networks (CNNs) to accurately detect and classify tumors, providing detailed insights into tumor type, size, and location. By harnessing the power of artificial intelligence, the system empowers healthcare professionals with timely and accurate diagnostic information, enabling early intervention and personalized treatment plans.

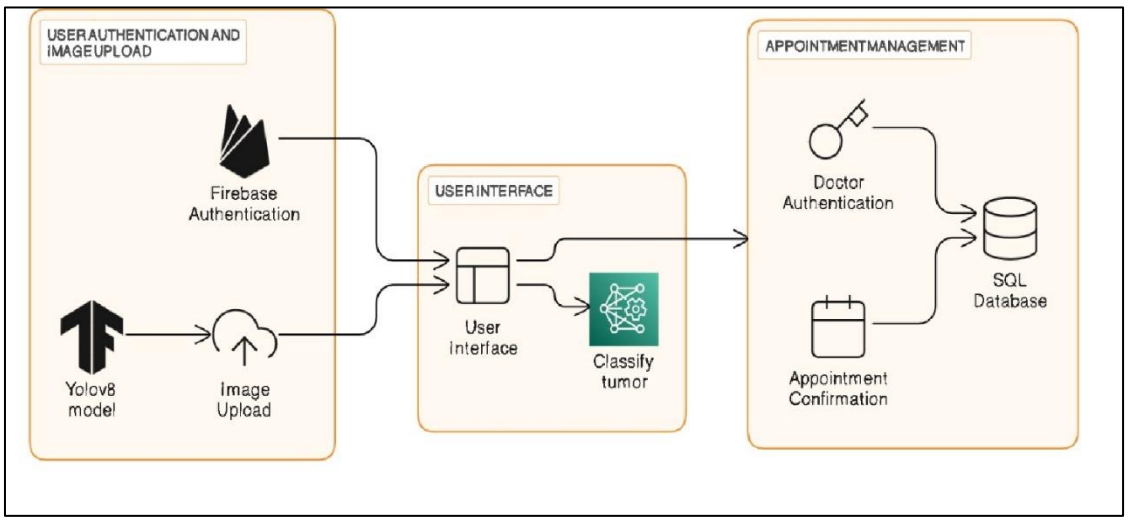

Fig 1: System Architecture

The Appointment Management module revolutionizes the process of appointment scheduling and management, facilitating seamless communication between patients and healthcare providers. Users can schedule appointments in real-time through the application, while healthcare providers can efficiently manage and confirm these appointments. Additionally, the module includes features such as attendance monitoring and appointment reminders to enhance patient engagement and adherence to treatment plans. Integration with a SQL database ensures efficient storage and retrieval of appointment data, enabling healthcare centers to streamline their operations and optimize patient care delivery.

The Authentication and Communication module ensures secure access and seamless communication within the healthcare software system. By leveraging Firebase authentication and TLS encryption, the system protects sensitive user data and ensures privacy and confidentiality. Real-time communication channels enable users to interact with healthcare providers for appointment scheduling, confirmation, and medical consultation, enhancing the overall patient experience and facilitating efficient healthcare delivery.

In summary, the proposed healthcare software system represents a significant advancement in the early detection and management of brain tumors. By integrating cutting-edge technologies, user-friendly interfaces, and robust security measures, the system aims to revolutionize healthcare processes, improve patient outcomes, and ultimately save lives.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134188

V. RESULT

The project yielded promising results across multiple fronts. Leveraging the YOLOv8 algorithm, our brain tumor detection module achieved an impressive accuracy rate of 98.6%, ensuring precise identification of tumors from MRI scans. This high level of accuracy is pivotal for early diagnosis and treatment planning. Furthermore, the appointment management system streamlined the scheduling process, allowing patients to book appointments in real-time, enhancing patient engagement and adherence to treatment plans. Real-time communication features facilitated seamless interaction between patients and healthcare providers, improving overall healthcare experiences.

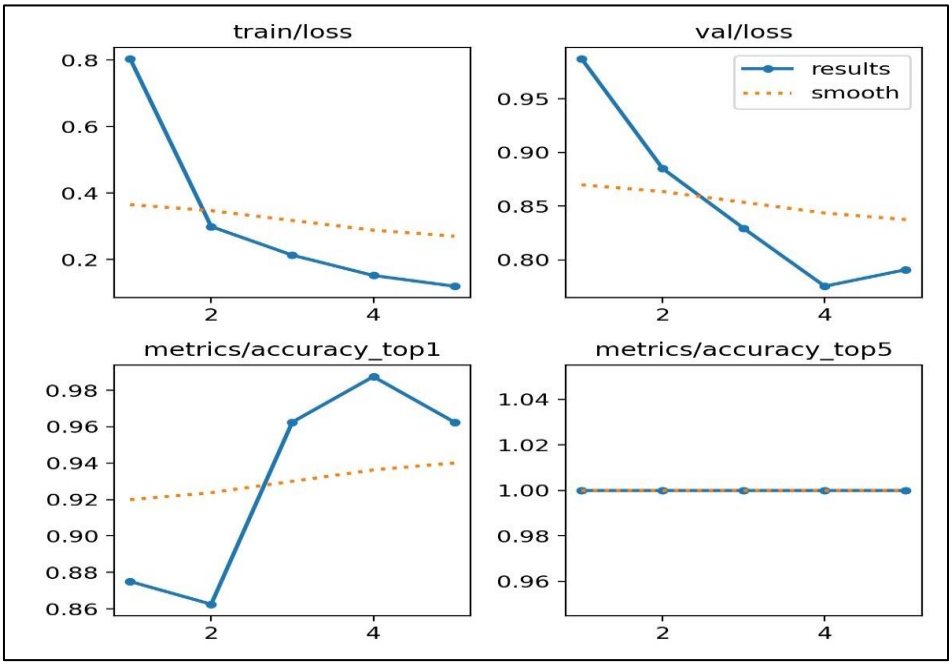

Fig 2 Results of loss and Precision

The project's results demonstrate significant advancements in healthcare management, particularly in the early detection and treatment of brain tumors.

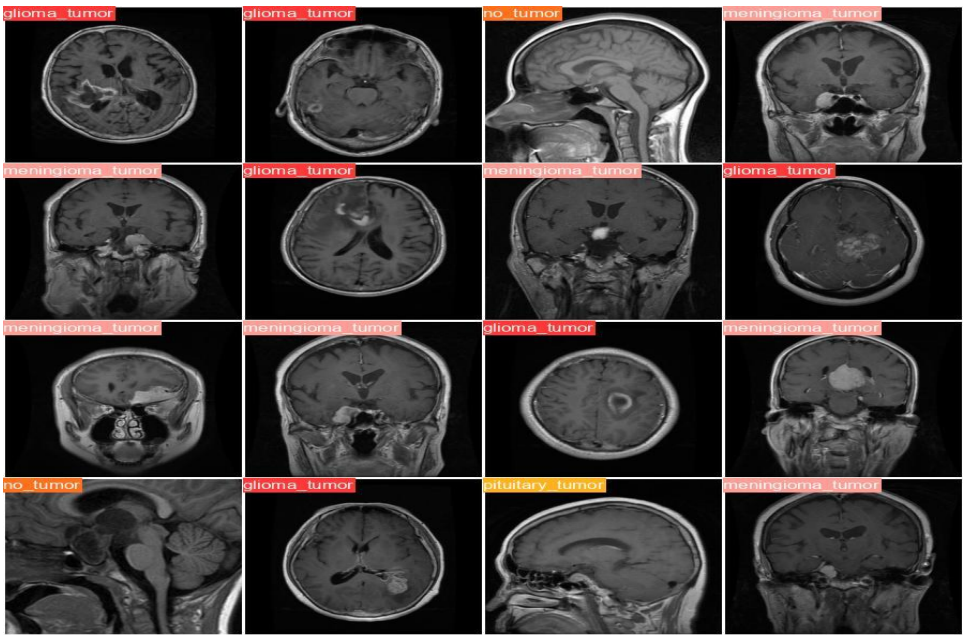

Fig 2: Prediction of tumor

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134188

VI. CONCLUSION AND FUTURE ENHANCEMENT

Our project integrates cutting-edge deep learning techniques with efficient appointment management to create a comprehensive medical system that transforms patient care. With a remarkable accuracy rate of 98.6%, our tumor detection module powered by YOLOv8 ensures precise and reliable results for medical image analysis. Seamlessly integrated with Firebase Authentication, users securely upload MRI images for analysis, while personalized user experiences and robust data security measures enhance system reliability.

The user-friendly interface facilitates easy appointment booking, enabling patients to schedule appointments and provide essential details effortlessly. The system's deep learning capabilities continuously learn and adapt, improving over time to ensure accuracy in diagnoses. This streamlines administrative tasks and optimizes patient-doctor interactions, leading to improved healthcare outcomes and increased patient satisfaction. With planned enhancements for direct communication with real hospitals, our system promises to elevate healthcare delivery further, offering accurate diagnoses and efficient appointment scheduling. By staying at the forefront of healthcare technology and incorporating feedback-driven improvements, we aim to drive positive impacts in medical care delivery, ensuring seamless experiences for patients and healthcare providers.

Planned enhancements for the healthcare software system include integrating with hospital appointment scheduling systems for seamless booking, incorporating real-time communication features like video conferencing and messaging, integrating Electronic Health Records (EHR) for access to patient medical histories, developing mobile applications for convenient access, implementing advanced analytics for insights into patient trends, enabling telemedicine consultations and remote patient monitoring, and exploring machine learning for more accurate tumor detection and personalized treatment recommendations. These enhancements aim to optimize clinical workflows, improve patient care, and drive better health outcomes.

REFERENCES

[1] Dr. R. Ramya, Nikhil Ravichandran, A. Surya Kumar, Varun S," Particle Swarm Optimization Technique to Detect Brain Tumor using YOLO Technology", Journal of Propulsion Technology, ISSN: 1001-4055 Volume 44 (2023).
[2] Tejas Shelatkar, Dr.Urvashi, Mohammad Shorfuzzaman, Abdulmajeed Alsufyani and Kuruva Lakshmanna," Diagnosis of Brain Tumor Using Light Weight Deep Learning Model with Fine-Tuning Approach", Research Article, Computational and Mathematical Methods in Medicine, ISSN 0377-0427,Volume 24,2022.
[3] S. Beatrice, Jay Yogesh Thanki, Tushar Ashok Dharia, Clive Jude D'Costa," Brain Tumor Detection Using CNN",International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653, Volume 10,2022.
[4] Ghada Saad, Ali Suliman, Luna Bitar and Shady Bshara," Developing a hybrid algorithm to detect brain tumors from MRI images", Egyptian Journal of Radiology and Nuclear Medicine, ISSN 2090-4762 ,2023.
[5] Abdullah A. Asiri, Ahmad Shaf, Tariq Ali, Muhammad Aamir, Muhammad Irfan," Brain Tumor Detection and Classification Using Fine-Tuned CNN with ResNet50 and U-Net Model: A Study on TCGA-LGG and TCIA Dataset for MRI Applications", Life 2023.
[6] A. Rehman, S. Naz, M. I. Razzak, F. Akram, and M. Imran, "A deep learning-based framework for automatic brain tumor classification using transfer learning," Circuits, Systems, and Signal Processing, ISSN 1531-5878, Volume 39, 2020.
[7] P. Khan, M. F. Kader, S. M. R. Islam et al., "Machine learning and deep learning approaches for brain disease diagnosis: principles and recent advances," IEEE Access, ISSN 2169-353, Volume. 9,2021.
[8] N. M. Dipu, S. A. Shohan, and K. M. A. Salam, "Deep learning-based brain tumor detection and classification," in International Conference on Intelligent Technologies (CONIT)IEEE, ISSN 1803–7232, 2022.
[9] K. M. Hosny, M. A. Kassem and M. M. Foaud "Skin Cancer Classification using Deep Learning and Transfer Learning", 9th Cairo International Biomedical Engineering Conference (CIBECISSN), ISSN 2156-6100, 2018.
[10] Md Shahin Ali, Md Sipon Miah, Jahurul Haque, Md Mahbubur Rahman and Md Khairul Islam (2021), "An enhanced technique of skin cancer classification using deep convolutional neural network with transfer learning models", Machine Learning with Applications, ISSN 1803–7232.
[11] Navarrete-Dechent C, Dusza SW, Liopyris K, Marghoob AA, Halpern AC, Marchetti MA), "Automated dermatological diagnosis: hype or reality?", J Invest Dermatol, ISSN 2277-2279,2018.
[12] Lee RS, Gimenez F, Hoogi A, Miyake KK, Gorovoy M, Rubin DL. A curated mammography data set for use in computer-aided detection and diagnosis research Scientific Data, ISSN 1803–7232, 2017.
[13] Moreira IC, Amaral I, Domingues I, Cardoso A, Cardoso MJ, Cardoso JS. INbreast: toward a full-field digital mammographic database. Acad Radiol. ISSN 2090-4762,2012.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134188

[14] Thuy Xuan Pham, Patrick Siarry, and Hamouche Oulhadj." A cooperating metaheuristic approach for MR image segmentation", Bio SMART 2019, 2019.
[15] N. M. Dipu, S. A. Shohan, and K. M. A. Salam, "Deep learning-based brain tumor detection and classification," in 2021 International Conference on Intelligent Technologies (CONIT)IEEE, ISSN 1803–7232,2021
[16] N. Noreen, S. Palaniappan, A. Qayyum, I. Ahmad, M. Imran, and M. Shoaib, "A deep learning model based on concatenation approach for the diagnosis of brain tumor," IEEE Access, ISSN 1803–7232, 2020.
[17] M. S. Majib, M. M. Rahman, T. M. S. Sazzad, N. I. Khan, and S. K. Dey, "VGG-SCNet: a VGG net-based deep learning framework for brain tumor detection on MRI images," IEEE Access, ISSN 1803–7232, 2021.
[18] G. S. Gaba, M. Hedabou, P. Kumar, A. Braeken, M. Liyanage, and M. Alazab, "Zero knowledge proofs based authenticated key agreement protocol for sustainable healthcare," Sustainable Cities and Society Journal, ISSN 1803–7232, Volume 80, 2022.
[19] M. Futrega, A. Milesi, M. Marcinkiewicz, and P. Ribalta, "Optimized U-net for brain tumor segmentation," International Conference on Intelligent Technologies, ISSN 1803–7232, 2021.
[20] M. A. Al-masni, M. A. Al-antari, J. M. Park et al., "Detection and classification of the breast abnormalities in digital mammograms via regional convolutional neural network," 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)IEEE, ISSN 2694-0604, 2017.