Brain tumour classification using neural Network

Mohammad fawas VS[1], Rahul ER[2] ,Soorya prakash KJ[3] ,Abhinand VD[4], Anand AA [5], Mohammad Hazeem PR[6], Ajith PJ[7] ,Bindu Anto[8]

[1] *Mohammad fawas VS Student, Computer Engineering, KKMMPTC Mala, Kerala, India*
[2] *Rahul ER Student, Computer Engineering, KKMMPTC Mala, Kerala, India*
[3] *Sooryaprakash KJ Student, Computer Engineering, KKMMPTC Mala, Kerala, India*
[4] *Abhinand VD Student, Computer Engineering, KKMMPTC Mala, Kerala, India*
[5] *Anand AA Student, Computer Engineering, KKMMPTC Mala, Kerala, India*
[6] *Mohammad Hazeem PR Student, Computer Engineering, KKMMPTC Mala, Kerala, India*
[7]*Ajith PJ HOD, Robotic process automation, Computer Engineering, KKMMPTC Mala, Kerala, India*
[8]*Bindu Anto HOD,Computer Engineering, KKMMPTC mala, kerala, india*

ABSTRACT

Recent development of technologies has created a major development in medical field .one of the most fatal disease brain tumour has been detected using these technologies. 2 D CNN has optimal accuracy in classifying brain tumour comparing the performance of various CNN and the machine learning methods by diagnosis of 3 type of brain tumour revealed that the 2 D CNN achieved exemplary performance and optimal execution time without latency this and encouraged radiologists and the physician to use this system for brain tumour detection .Recent advancements in the field of machine learning, specifically within deep learning, have enabled the recognition and categorization of patterns within medical images. In image process that most successful technique used to CNN has they have many layers and diagnosing accuracy Machine learning is rapidly emerging as a valuable asset across various medical domains, encompassing tasks like disease prognosis, diagnosis, the identification of molecular and cellular structures, tissue segmentation, and image classification Machine learning methods, particularly deep learning, can be crucial in examining, dividing, and categorizing cancer images, particularly those related to brain tumours . Additionally, employing these techniques enables precise and mistake-free tumour recognition, distinguishing them from other similar ailments

Keyword : - *Brain tumour, deep learning, machine learning algorithms, image classification, CNN-convolution neural network*

INTRODUCTION

Simulink, a multi-domain simulation and model-based design environment, is employed for tumor classification, distinguishing between malignant and non-cancerous tumors. Simulink offers simulation capabilities, automated code generation, and continuous testing and validation of embedded systems. Additionally, it provides a graphical editor, adaptable component libraries, and solvers for modeling and simulating dynamic systems.

"The utilization of neural networks for brain tumor categorization represents a pioneering use of artificial intelligence within the domain of medical diagnosis. This progressive methodology employs deep learning methods to assess medical imagery, including MRI scans, with remarkable precision in order to classify brain tumors into various categories and stages. Through the application of neural networks, this approach holds the promise of early detection, exact diagnosis, and tailored treatment strategies, ultimately enhancing patient results in the complex field of brain tumor care."

MILESTONES

On the October 1995, "A survey paper based on image retrieval system":[1] Images are being produced increasingly from various sources, including defense and civilian satellites, military reconnaissance and surveillance flights, fingerprinting and mug-shot-capturing devices, scientific experiments, biomedical imaging, and home entertainment systems. For instance, NASA's Earth Observing System is expected to generate approximately 1 terabyte of image data daily when fully operational. To effectively and efficiently utilize this vast image data, a content-based image retrieval (CBIR) system is essential. This system aids users, even those unfamiliar with the database, in retrieving relevant images based on their content. CBIR finds applications across numerous and diverse fields, and it has garnered the interest of researchers from various disciplines due to the recent focus on multimedia systems.

In 1988,the paper named " Adrenal masses charaterization with T1 -waited MR imaging,"[2] written by Chemar JL, Robins SM, Nelson RC, Stein berg HB, Torres WE, Bernardino ME: The study investigated the capability of a T1-weighted spin-echo magnetic resonance (MR) sequence to distinguish between benign and malignant adrenal masses at 0.5 T in a group of 28 patients with a total of 35 adrenal masses. Among these masses, those with an adrenal mass-liver signal intensity ratio of 0.71 or lower (nine in total) were confirmed as metastases, while those with a ratio of 0.78 or higher (15 in total) were identified as adenomas. There were 11 masses (31%), including six adenomas, three metastases, one pheochromocytoma, and one neuroblastoma, with ratios falling between these values. For masses with adrenal mass-fat intensity ratios, those with ratios of 0.35 or lower (nine out of ten) were determined to be metastases, and all 12 masses with ratios of 0.42 or higher were benign. Eleven masses (31%), consisting of four malignant and one benign, had ratios within this intermediate range. In two cases, ratios could not be calculated due to the absence of fat. T1-weighted MR imaging demonstrated a specificity similar to that of T2-weighted imaging in distinguishing between benign and malignant adrenal masses. However, there was still notable overlap between the two, as reported in T2-weighted imaging studies. Therefore, although both imaging sequences can aid in distinguishing between benign and malignant adrenal masses in certain cases, a biopsy remains essential when a precise histological diagnosis is required.

An article was published in October 2021, title " Human activity recognization using convolution neural network" [3] by Gulustandogan, Sinem sena ertas, Iremnaz cay: Utilizing smartphone sensors to identify human actions can offer several advantages due to the wealth of data they can provide. In this research, we introduce a deep learning method based on sensor data for the purpose of recognizing human activities. Our proposed approach relies on linear accelerometer (LAcc), gyroscope (Gyr), and magnetometer (Mag) sensors to detect eight different transportation and movement activities. These activities encompass Still, Walk, Run, Bike, Bus, Car, Train, and Subway. To carry out this investigation, we employ the Sussex-Huawei Locomotion (SHL) Dataset, which involves data from three participants, to discern the physical activities of users. We use Fast Fourier Transform (FFT) spectrograms generated from the three axes of LAcc, Gyr, and Mag sensor data as the input for our Convolutional Neural Network (CNN) model. The experimental findings regarding human activity recognition demonstrate the effectiveness of our user-independent approach when compared to competitive benchmarks.

On December 2017,"A survey paper based on application of deep convolution neural network ": [4] Convolutional neural networks (CNNs) have a rich history in the domains of digital image processing and speech recognition, where they have demonstrated remarkable success. Before the advent of CNNs, both image processing and speech recognition heavily relied on traditional machine learning algorithms. Although these conventional approaches yielded significant achievements, further progress became challenging to attain, prompting the development of CNNs. Currently, CNNs have reached a level of maturity in the realms of image processing and speech recognition. Both theoretical research and industrial applications have flourished, propelling CNNs into a phase of significant advancement. The triumph of CNNs in image processing and speech recognition has ignited a surge of research interest in applying them to natural language processing. In the context of natural language processing, CNNs have found widespread utility, albeit with room for improvement in their performance. This paper aims to provide a clearer exposition of the CNN structure while also offering a concise overview and outlook on ongoing CNN research in image processing, speech recognition, and natural language processing.

The publication tilted " Cascading hand crafted features and convolution neural network for IOT -enabled brain tumour segmentation " [5] A survey by Hikmat khan, Cirmasoom shah, Munam ali shah , Saif ul islam, Joel J.P.C. Rodrigues .The medical field has been transformed by the Internet of Things (IoT), which enables the collection of data through various IoT devices. These devices produce data in different formats, such as text, images, and videos. Consequently, extracting precise and valuable information from the vast volume of IoT-generated data is a formidable challenge. Recently, there has been a growing focus on the segmentation of brain tumors from images generated by IoT devices, presenting a promising but complex problem due to the diverse appearances of tumors. Existing methods employ either handcrafted feature-based techniques or Convolutional Neural Networks (CNNs). In this study, a novel approach for fully automatic brain tumor segmentation is proposed, intelligently combining handcrafted features and CNNs. Initially, three handcrafted features, including mean intensity, Local Binary Pattern (LBP), and Histogram of Oriented Gradients (HOG), are computed. Subsequently, Support Vector Machine (SVM) is utilized for pixel classification, resulting in the creation of a Confidence Surface Modality (CSM). This CSM, in combination with Magnetic Resonance Imaging (MRI) data, is input into a unique three-pathway CNN architecture. In experiments conducted on the BRATS 2015 dataset, the proposed method demonstrates promising results, achieving Dice similarity scores of 0.81, 0.76, and 0.73 for complete, core, and enhancing tumors, respectively.

In 2018,the paper named "Type-2 fuzzy ontology–aided recommendation systems for IoT–based healthcare, Comput. Commun" [6] written byFarman Ali, SM Riazul Islam, Daehan Kwak, Pervez Khan, Niamat Ullah, Sang, Jo Yoo, Kyung Sup Kwak:The prevalence of chronic diseases is on the rise, posing increasingly complex challenges for the healthcare sector. Currently, there are various healthcare systems based on ontology and the Internet of Things (IoT) aimed at intelligently overseeing long-term care for chronic patients. These systems primarily aim to reduce manual efforts in recommendation systems. However, due to the heightened risks and uncertainties associated with diabetes patients, these healthcare systems struggle to accurately extract precise physiological data from patients. Additionally, existing ontology-based methods fail to derive optimal membership values for risk factors, resulting in subpar outcomes.In response to these issues, this paper introduces a recommendation system for IoT-based healthcare, bolstered by type-2 fuzzy ontology. This system effectively monitors patients' health while providing specific dietary and medication recommendations. The proposed system extracts patient risk factor values, assesses the patient's health status through wearable sensors, and suggests diabetes-specific prescriptions for a smart medicine box and food for a smart refrigerator. The integration of type-2 Fuzzy Logic (T2FL) and fuzzy ontology substantially enhances the accuracy of predicting a patient's condition and the precision of drug and food recommendations.To facilitate decision-making, the ontology includes information about the patient's medical history, dietary habits, and prescribed medications. This knowledge is harnessed through Protégé Web Ontology Language (OWL)-2 tools, employing Semantic Web Rule Language (SWRL) rules and fuzzy logic to automate the recommendation process. Furthermore, Description Logic (DL) and Simple Protocol and RDF Query Language (SPARQL) queries are employed for ontology evaluation.Experimental results demonstrate the efficiency of the proposed system in extracting patient risk factors and providing diabetes-related prescriptions.

The publication titled "Deep Convolutional Neural Network Transfer Learning Optimization Based on Visual Interpretation"[7] A Survey by Yibo Xu; Jiongming Su; Fengtao Xiang; Ce Guo; Haoran Ren; Huimin Lu .In image classification tasks, training deep convolutional neural networks typically demands a substantial volume of data. Given the practical constraints of environmental limitations, resource availability, and time constraints, it becomes highly valuable to achieve higher recognition accuracy with a reduced number of training samples in the shortest possible duration. To address this challenge, a specific image classification task benefits from a novel optimization approach based on visual interpretation within a deep convolutional neural network transfer learning framework. Firstly, the method utilizes class activation mapping visualization as a visual interpretation tool, generating class activation heat maps for the validation set images. This allows for an in-depth analysis of the reasons behind misclassification in these images. Secondly, a "feedback" mechanism is introduced, involving pre-recognition and visualization of an optimized dataset using a model initially trained on the original dataset. This step aims to identify the images that exert the most significant influence on enhancing recognition accuracy, thereby maximizing their impact on the original model.Finally, the model undergoes retraining on the optimized training set. Experimental results demonstrate the efficacy of this approach in significantly improving the recognition accuracy of the transfer learning model for image classification.

An article published in titled" Exploiting IoT technologies for enhancing Health Smart Homes through patient identification and emotion recognition, Comput Commun ." [8] By Leandro Y. Mano, S. Bruno, Luis Faiçal, H.V. Nakamura, Pedro H. Gomes, Giampaolo L. Libralon, I. Rodolfo, Meneguete, P.Rocha Geraldo, Filho:Currently, there is a growing trend of providing medical care at home, particularly in countries like Japan, the USA, and Europe. Moreover, there has been a significant rise in the elderly population over the past 15 years, many of whom receive in-home care and occasionally find themselves in critical situations, such as accidents or depression. The advancement of ubiquitous computing and the Internet of Things (IoT) has brought forth cost-effective equipment with wireless communication capabilities and cameras, such as smartphones or embedded devices like Raspberry Pi. Embedded computing has paved the way for Health Smart Homes (HSH), which can greatly improve in-home medical treatment. However, the utilization of cameras and image processing within the IoT context, especially concerning HSH, remains an underexplored area in the literature. While images have been extensively used for safety and surveillance in homes, their application in assisting patients and the elderly within home-care systems has been limited. We believe that these images can play a pivotal role in aiding nurses and caregivers in providing timely assistance, and their integration can be both straightforward and affordable thanks to IoT technologies. This article delves into the use of patient images and emotional detection to support patients and the elderly in the context of in-home healthcare. Additionally, we examine existing research and find that most studies in this field do not leverage images for patient monitoring, and only a few consider the emotional well-being of patients, which is crucial for their recovery. Finally, we introduce our prototype, compatible with multiple computing platforms, and present results that demonstrate the viability of our approach.

In October 2021, the paper named A Review of Convolution Neural Network Used in Various Applications "[9] written by Parul Choudhary , Pooja Pathak ,The deep learning technique known as Convolutional Neural Networks (CNN) proves highly effective at automatically detecting features within images. CNNs have the capability to train on vast datasets containing billions or millions of parameters, taking images as input and convolving them with specific filters to generate desired outputs. CNNs find applications in diverse fields, including image recognition, image classification, and image detection. This paper offers a comprehensive review of the literature on CNNs applied across various domains, including medicine, agriculture, and document layout. Furthermore, it discusses the development of numerous CNN models designed to assess their performance in image detection and recognition tasks. Consequently, this paper conducts a comparative analysis of these models in relation to the datasets used, with the aim of providing valuable guidance to newcomers in this domain.

The publication titled "Object Detection Using Convolutional Neural Networks" [10] An survey by Reagan L. Galvez; Argel A. Bandala; Elmer P. Dadios; Ryan Rhay P. Vicerra; Jose Martin Z. Maningo Vision systems play a pivotal role in the development of mobile robots assigned with specific tasks such as navigation, surveillance, and explosive ordnance disposal (EOD). These systems provide crucial environmental awareness to the robot's controller or operator, facilitating the execution of subsequent tasks. Recent advancements in deep neural networks applied to image processing have now made it feasible to accurately classify and detect objects.In this research paper, Convolutional Neural Networks (CNNs) are employed for object detection within the robot's surroundings. The study compares two state-of-the-art models for this purpose: the Single Shot Multi-Box Detector (SSD) with MobileNetV1 and the Faster Region-based Convolutional Neural Network (Faster-RCNN) with InceptionV2. The results indicate that one of these models is well-suited for real-time applications due to its speed, while the other excels in achieving more precise object detection.

CONCLUSIONS

"In summary, employing neural networks for brain tumor classification marks a substantial advancement in the field of medical imaging and diagnostic practices. This innovation has the capacity to transform patient care by facilitating early detection, accurate categorization, and personalized treatment approaches for individuals dealing with brain tumors. As ongoing research and development in this domain progress, we can foresee heightened precision and clinical applicability, leading to improved patient well-being and the efficacy of medical interventions in combatting brain tumors."

REFERENCES

[1].Gudivada VN and Raghavan VV_ Content_based image Retrieval systems_IEEE Computer, 28(9):18-22,1995.
[2].Chezmar JL_ Robbins SM_ Nelson RC_ Steinberg HV_ Torres WE_ and Bernardino ME_ Adrenal masses_ Characterization with T1-weighted MR imaging_ Radiology. 166(2):357-359,1988.
[3].Human Activity Recognition Using Convolutional Neural Networks Gulustan Dogan; Sinem Sena Ertas; İremnaz Cay October 2021
[4].Application of deep convolution neural network Jiudong Yang; Jianping Li December 2017
[5].Hikmat Khan, Pir Masoom Shah, Munam Ali Shah, Saif ul Islam, Joel, J.P. C. Rodrigues, Cascading handcrafted features and Convolutional Neural Network For IoT-enabled brain tumor segmentation, Comput. Commun. 153 (2020) 196–207.
[6].Farman Ali, SM Riazul Islam, Daehan Kwak, Pervez Khan, Niamat Ullah, Sang-Jo Yoo, Kyung Sup Kwak, Type-2 fuzzy ontology–aided recommendation systems For IoT–based healthcare, Comput. Commun. 119 (2018) 138–155
[7].Deep Convolutional Neural Network Transfer Learning Optimization Based on Visual Interpretation Yibo Xu; Jiongming Su; Fengtao Xiang; Ce Guo; Haoran Ren; Huimin Lu July 2021
[8].Leandro Y. Mano, S. Bruno, Luis Faiçal, H.V. Nakamura, Pedro H. Gomes, Giampaolo L. Libralon, I. Rodolfo, Meneguete, P.Rocha Geraldo, Filho, et al., Exploiting IoT technologies for enhancing Health Smart Homes through patient Identification and emotion recognition, Comput. Commun. 89 (2016) 178–190
[9]A Review of Convolution Neural Network Used in Various Applications Parul Choudhary; Pooja Pathak October 2021
[10] Object Detection Using Convolutional Neural Networks Reagan L. Galvez; Argel A. Bandala; Elmer P. Dadios; Ryan Rhay P. Vicerra; Jose Martin Z. Maningo October 2018