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Medical Imaging Using Convolutional Neural Network

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ABSTRACT

Medical imaging is a method that uses medical images of various parts of the body for treatment purposes. There can be various implementations based on its usage.

Digitization and automation across all industries have resulted in improvements in the efficiencies and effectiveness of systems and processes, and there is a need for systems which can help doctors treat and diagnose efficiently.

Medical imaging using convolutional neural networks offers a systematic and efficient ways to diagnose medical problems.

KEYWORDS: Medical Imaging, Convolutional Neural Networks, Deep Learning, Image Analysis, Diagnostic Imaging

INTRODUCTION

The modern world is enclosed with gigantic masses of digital visual information. To analyze and organize these devastating oceans of visual information, image analysis techniques are major requisite. In particular, Medical image classification plays an essential role in clinical treatment and teaching tasks. It has emerged as one of the top research area in the field of engineering and medicine. Recent years have witnessed rapid use of machine learning algorithms in medical image analysis.The application of Convolutional Neural Networks in medical imaging has the potential to revolutionize healthcare by improving diagnostic accuracy, reducing human error, and enhancing patient care.

The project uses image analysis for object detection and recognition in order to determine the activities and track objects. Here, Machine learning is used to train the machine for a particular set of images so that a system can be implemented for the application of Convolutional Neural Networks (CNNs) in the field of medical imaging.

METHODOLOGY

The program will work as a medical imaging system that will store different images, and use them to identify for assistance to the doctors.

The basic idea of the proposed system is that the user once gives the medical image data to the program,the program then uses machine learning algorithms and the previously stored data to verify the medical condition in the medical image.While at the same time uses the data from the new image to update the database and improve the algorithms.This system is improved more when there is more data in the system.

After successfully storing the information in the database, a user can simply provide the medical image and then this image is sent back to the backend and the respective image is shown with the result to the user after it is checked by the system.If the information for the image does not exist in the system, the user can add it in the database.

DEEP LEARNING

Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks. Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Learning can be supervised, semi-supervised or unsupervised.

Deep learning models are loosely related to information processing and communication patterns in a biological nervous system, such as neural coding that attempts to define a relationship between various stimuli and associated neuronal responses in the brain.

Deep learning architectures such as deep neural networks, deep belief networks and recurrent neural networks have been applied to fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, bioinformatics and drug design, where they have produced results comparable to and in some cases superior to human experts.

NEURAL NETWORKS

In machine learning, a convolutional neural network (CNN, or ConvNet) is class of deep, feed-forward artificial neural networks that has successfully been applied to analyzing visual imagery.

CNNs use a variation of multilayer perceptrons designed to require minimal preprocessing. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics.

Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex. Individual cortical neurons respond to stimuli only in a restricted region of the visual field known as the receptive field. The receptive fields of different neurons partially overlap such that they cover the entire visual field. CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage. They have applications in image and video recognition, recommender systems and natural language processing.

DEVELOPMENT

Being an important phase of software development, the design of the application's architecture was highly considered.

The application has a front end that acts as an interface to the users of the application and a backend that aids in the management of the application. The features of both are listed below.

Front-End

- The Front End of the Application provides several functionalities to the users:
- Users can check and verify the medical image
- They can change the information if they wish.
- It allows users to store the medical images and their information.

Back-End

The Back End of the Application is used by the administrator:

- Administrators can add/delete/edit the information in the database.
- Administrators can update the database.
- He can change the status of a User.

The programming languages used in the development of the software were as follows:

Html was used in making the front end of the software. Javascript was used in making the logic of the software.CSS was used to design and beautify the external look of the software.Flask was used due to its various features.Python was used in the backend and server of the system. These Languages were used due to their popularity, how easy they were to learn and use and their compatibility with each other. Microsoft Visual Studio Code was used as the code editor to program these scripts.During implementation, most of the functionalities were developed as small chunks of code.

We also did intensive testing and debugging to make sure our program was working correctly.

RELATED WORK

Deep convolutional neural network based medical image classification for disease diagnosis

This paper researches how to apply the convolutional neural network (CNN) based algorithm on a chest X-ray dataset to classify pneumonia. Three techniques are evaluated through experiments. These are linear support vector machine classifier with local rotation and orientation free features, transfer learning on two convolutional neural network models: Visual Geometry Group i.e., VGG16 and InceptionV3, and a capsule network training from scratch.

Medical Image Analysis using Convolutional Neural Networks: A Review

Among deep learning techniques, deep convolutional networks are actively used for the purpose of medical image analysis. This includes application areas such as segmentation, abnormality detection, disease classification, computer aided diagnosis and retrieval. In this study, a comprehensive review

of the current state-of-the-art in medical image analysis using deep convolutional networks is presented. The challenges and potential of these techniques are also highlighted.

Convolutional neural networks in medical image understanding: a survey

This article aims to provide a comprehensive survey of applications of CNNs in medical image understanding. The underlying objective is to motivate medical image understanding researchers to extensively apply CNNs in their research and diagnosis. A brief introduction to CNNs has been presented. A discussion on CNN and its various award-winning frameworks have been presented. The major medical image understanding tasks, namely image classification, segmentation, localization and detection have been introduced.

Convolutional neural networks for medical image analysis: State-of-the-art, comparisons, improvement and perspectives

In this paper, authors provide a survey on convolutional neural networks in medical image analysis. First, we review the commonly used CNNs in medical image processing, including AlexNet, GoogleNet, ResNet, R-CNN, and FCNN. Then, we present an overview of the use of CNNs, for image classification, segmentation, detection, and other tasks such as registration, content-based image retrieval, image generation and enhancement

EXISTING SYSTEM DRAWBACKS

One of the significant drawbacks of implementing a system for medical imaging using Convolutional Neural Networks (CNNs) is the extensive requirement for high-quality, labeled data. Training CNN models effectively demands large, diverse, and well-annotated medical image datasets. In many cases, these datasets can be challenging to obtain due to privacy concerns, as healthcare data is sensitive and subject to strict regulations. Moreover, there can be a substantial scarcity of labeled data for certain rare diseases or conditions, limiting the model's ability to accurately detect and diagnose them. This data limitation not only hampers the development and training of robust CNN models but also introduces the risk of model biases, as training data might not adequately represent the full spectrum of patient diversity and clinical scenarios. Additionally, the time and effort required for manual annotation by medical professionals can be substantial. Overcoming these data-related challenges is an ongoing issue that researchers and practitioners in this field must address to maximize the potential of CNNs in medical imaging and healthcare.

RESULT AND DISCUSSION

This system aids in increasing the efficiency and performance required in this system. It also gives users many different advantages in many different aspects In addition, it ensures that the system is user-friendly and authentic.

CONCLUSION

This system is designed for the actual implementation of Convolutional neural network in medical imaging to allow users to easily identify the medical images in a picture.

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