

DEVELOPMENT OF LIGHT WEIGHT DEEP LEARNING IOT INTERFACE ALGORITHM FOR BIOMEDICAL IMAGE ANALYSIS

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Abstract

Biomedical engineering and healthcare sectors are one of the most crucial areas of an industry. The image analysis always been a first level decision maker for experts. Image analysis now-a-days not remained limited for medical and biomedical applications but also extended for many other applications like plant pathological use to identify plant/crop diseases or algae studies. Also, the concept of Internet of Things is now not limited to connect core things but eventually can be used as an interface for deep learning modules to club the benefits of both technologies. Hence, this paper presents the development of light weight deep learning IoT interface where it is proved that, IoT interface can boost the capability of identification of image parameters to the actual user interface. The accuracy can be boosted as compared to existing deep learning modules and also segmentation images can be uploaded to Hadoop Big data server.

Keywords: IoT; deep learning; machine learning; image analysis

1. Introduction

The Internet of Things (IoT) integrates billions of smart devices that can communicate with one another with minimal human intervention. IoT technologies play a crucial role in enhancing several real-life smart applications that can improve life quality [1]. On the other hand, the crosscutting nature of IoT systems and the multidisciplinary components involved in the deployment of such systems have introduced new security challenges. Internet-of-Underwater-Things (IoUT) devices are utilized in the ocean environment [2]. Also, Implementing security measures, such as encryption, authentication, access control, network security and application security, for IoT devices and their inherent vulnerabilities is ineffective [3]. Therefore, existing security methods should be enhanced to secure the IoT ecosystem effectively. Machine learning and deep learning (ML/DL) have advanced considerably over the last few years, and machine intelligence has transitioned from laboratory curiosity to practical machinery in several important applications [4]. Integrating the Internet of Things (IoT) in citizens' lives enables the innovation of new intelligent services and applications that serve sectors around the city, including healthcare, surveillance, agriculture, etc. IoT devices and sensors generate large amounts of data that can be analyzed to gain valuable information and insights that help to enhance citizens' quality of life. Deep Learning (DL), a new area of Artificial Intelligence (AI), has recently demonstrated the potential for increasing the efficiency and performance of IoT big data analytics [5]. Hence, it is necessary to develop soft IoT broker

in terms of algorithm to merge with the deep learning and/or artificial intelligence modules. In this paper, section 2 provides the technical literature review, section 3 presents the proposed research methodology where newly developed algorithm is provided and section 4 concludes this ongoing research.

2. Literature Review

In previous section various possible applications of IoT with deep learning are discussed. In this section, technical aspects of deep learning are provided which can be an important tool for identification of research direction.

Author proposed MCU Net, a system-model co-design framework that enables Image Net scale deep learning on off-the-shelf microcontrollers. To handle the scarce on-chip memory on microcontrollers, author jointly optimized the deep learning model design (Tiny NAS) and the inference library (Tiny Engine) to reduce the memory usage [6]. Deep Learning is a resolution of automation of predictive analytics. DL utilized in agriculture for different Applications, for example fruit counting, and crop classification or plant classification, detection of fruit type, hydroponic agriculture. Healthy crops must be produced for supportable agriculture. Deep Learning has demonstrated effective in tackling complex issues like picture recognition, object detection, natural language processing, image classification, image segmentation. Classification accuracy of deep learning gives outstanding results on the large quantity of data so there is a need of big quantity of training dataset [7].

A deep neural network (DNN) has fetched many advantages in machine learning. Since its invention, the DNN has been used in numerous applications especially in image and speech signal processing. The DNN has achieved very high accuracy in applications related to image and speech processing. The deep network requires a large amount of data for training [8].

IoT framework can be utilized to classify stroke through CT images deploying Convolutional Neural Networks (CNN) to recognize if the brain is healthy, the stroke is ischemic, or a stroke happened because of bleeding. The advantages of employing IoT in healthcare are less human-dependent areas, leading to fewer human errors. Limitation of this study: we cannot use the proposed structure in other medical images, yet the expansion of this system is required [9].

Author outlined the importance of DL, presents the types of DL techniques and networks. It then presents convolutional neural networks (CNNs) which the most utilized DL network type and describes the development of CNNs architectures together with their main features, e.g., starting with the AlexNet network and closing with the High-Resolution network (HR.Net) [10].

Hyper spectral image classification (HSIC) methods based on convolutional neural network (CNN) continue to progress in recent years. However, high complexity, information redundancy, and inefficient description still are the main barriers to the current HSIC networks. To address the mentioned problems, author presented a spatial-spectral dense CNN framework with a feedback attention mechanism called FADCNN for HSIC in this article. The proposed architecture assembles the spectral-spatial feature in a compact connection style to extract

sufficient information independently with two separate dense CNN networks [11]. In this research, author first trained the CNN model by transfer learning. Further, the features of the convolution layer and the fully connected layer are extracted respectively. These extracted features are then passed into the auto encoder for further learning with Softmax normalisation to obtain the adaptive weights for performing final classification. Experiments demonstrated that the proposed method achieves higher CSI image classification performance compared with fix weights feature fusion [12].

Author proposed a two-stage selective ensemble of CNN branches via a novel training strategy called deep tree training (DTT). In this approach, DTT is adopted to jointly train a series of networks constructed from the hidden layers of CNN in a hierarchical manner, leading to the advantage that vanishing gradients can be mitigated by supplementing gradients for hidden layers of CNN, and intrinsically obtain the base classifiers on the middle-level features with minimum computation burden for an ensemble solution [13]. In health applications, where a lot of data are accessible, deep learning algorithms have the potential to perform well. In this paper, author(s) develop a deep learning architecture called the convolutional neural network (CNN), which was examined in this study to see if it can be implemented. The study uses the IoT system with a centralized cloud server, where it is considered as an ideal input data acquisition module [14]. But, cloud server processing took much time for data analysis so it is suggested that to develop IoT interface using CNN.

Moreover, deep learning architectures like convolutional neural networks (CNNs) have presented a scope to extract the underlying features from the large-scale input images in providing better solutions for tasks such as automatic road detection that come at the cost of time and memory overhead. In this regard, we have proposed a three-layer edge-fog-cloud-based intelligent satellite IoT architecture that uses the super pixel-based CNN approach. At the fog layer, the super pixel-based simple linear iterative cluster (SLIC) algorithm uses the images captured by the satellites of the edge level to produce the smaller-sized super pixel images that can be transferred even in a low bandwidth link [15].

3. Research Methodology

Existing research directs to develop a deep learning and IoT ensemble algorithm where soft computing can be carried out. Though IoT is using the 'Things', now CoAP, MQTT protocol handling can be redirected via soft broker to participate in a deep learning training and validation. In this section, we providing new deep learning algorithm with IoT broker ensemble framework. Existing research proposed a modular group attention block that can capture feature dependencies in medical images in two independent dimensions: channel and space. By stacking these group attention blocks in ResNet-style, we obtain a new ResNet variant called ResGANet [16]. The proposed methodology is intended to develop IoT Soft Broker where Convolution Neural Network can be modified to feed the brain tumor image segmentation to digital medical device. The soft broker can able to record and store the segmentation results and can upload patient images to hospital big data Hadoop server. Following Fig.1 shows the proposed methodology.

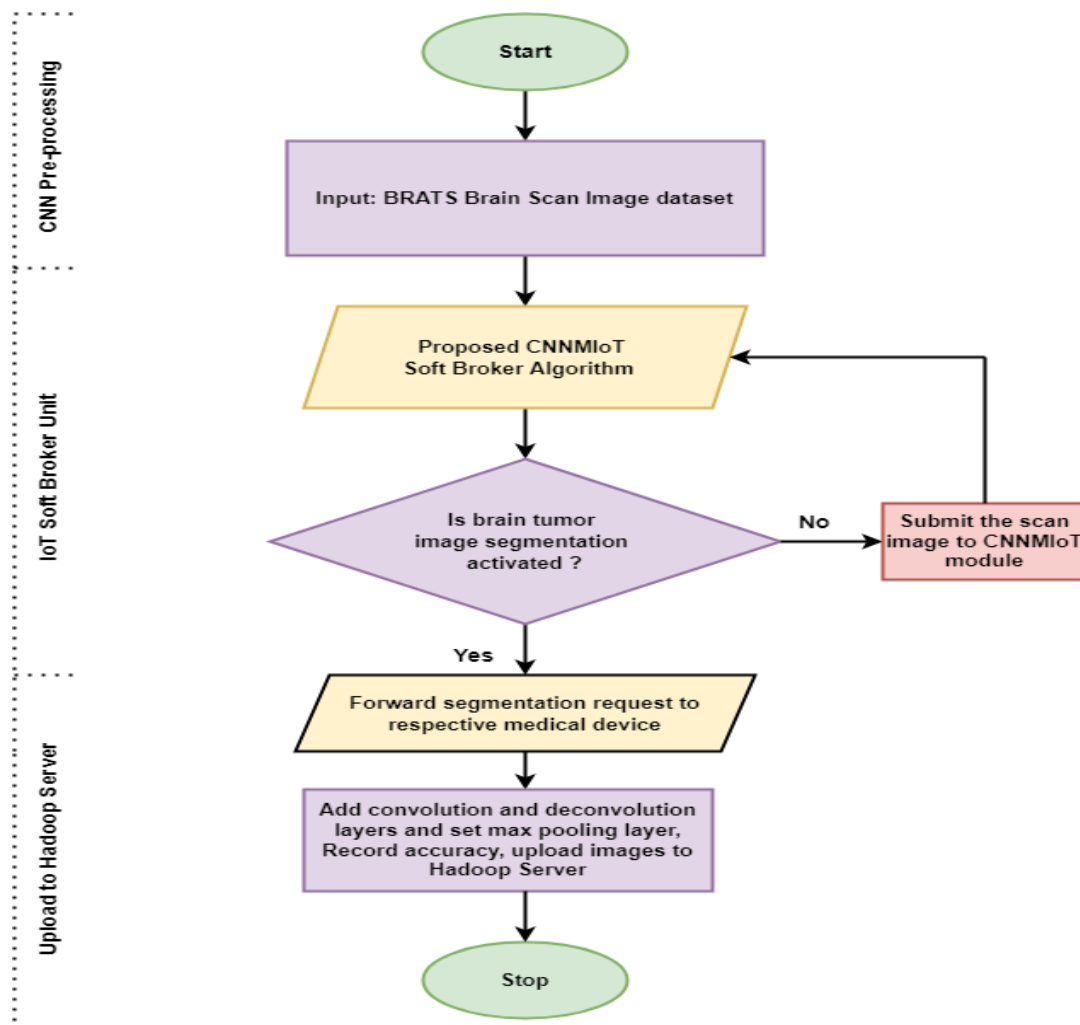


Fig. 1: Representation of Proposed Methodology

The main goal of IoT is to connect the things they use to communicate with each other for data analysis and sharing. If all the things that people use in a default household could perform this task, then the work that the average human being does could be a lot easier. The content is presented as a survey on application layer protocol and the major role it plays in communication between two machines and how they use the protocol to communicate with each other. The uses of various soft computing paradigms that can be used are discussed in this paper [17].

Algorithm: CNNMIoT Soft Broker

Input: BRATS Dataset, Medical device ID, Hadoop Server PortID

1. Array Medddb []; // this will store BRATS images sequentially for pre-processing
2. Array IoT Request []; //To store incoming segmentation request
3. Array ConvLayer []; //Add convolution layer

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4. Array DeConvLayer []; // Add deconvolution layer
5. If {ConvLayer [] != DeConvLayer[]}
Go to step 4 and/or step 5
}
Else {
Add MxPoolLayer []
}
6. Calculate accuracy
7. Send accuracy details to medical deviceID
8. Upload the results to Hadoop server PortID
9. End

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In this existing work, the genetic algorithm and CNN are used to determine the brain tumor classification based on the principle of registration and this is achieved by loading the image. After that, image is processed in regard with smoothing, reducing noise, by using Gaussian filter. Genetic algorithm is also applied to achieve the principle of registration, then, CNN is used to classify the brain tumor for output via GSM [18]. Hence, in proposed research, proposed CNNMIoT algorithm can process IoT protocols as a redirection to intended medical device and soft broker works with the help of admin-scripts to upload segmentation results to Hadoop Big Data Server. The proposed method performs better in terms of utility of modules and CNNMIoT can improve the accuracy.

4. Conclusion

In medical IoT domain, the data storage is an important factor. Manual image scan storage needs physical space and man power. Also, data security is difficult in manual data handling. Hence, there is a need of IoT technique which can automatically store necessary scan results with easy and secure access with the help of medical device outputs. The proposed algorithm CNNMIoT soft broker able to forward the request from segmentation output of BRATS dataset to medical device and Hadoop big data server. The proposed system is better in utility performance as compared to genetic algorithm modules. This system can be an efficient IoT solution for healthcare organizations where scanned data can be directly stored to big data server.

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