Abstract

Artificial intelligence (AI) refers to the simulation of human intelligence by software-coded heuristics. It is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the simplest ones to the more difficult or complex ones. Its ideal characteristic is its ability to rationalize and take actions that have the best chance of achieving a specific goal. A subset of AI is machine learning (ML), which refers to the concept that computer programs can automatically learn from and adapt to new data without being assisted by humans. Deep learning techniques enable this automatic learning through the absorption of huge amounts of unstructured data such as text, images, or video.

The applications for AI in today's society are endless. The technology is applied to many different sectors and industries such as healthcare, astronomy, gaming, finance, data security, social media, transport, automotive industry, robotics, entertainment, e-commerce, agriculture, education, etc. AI is making our daily life more comfortable and fast.

In this thesis, research on some of the applications of AI involving deep learning in healthcare sectors is highlighted. Research is being carried out in exploring the use of deep learning in ophthalmology in diagnosing retinal images for detection of some diseases through use of Optical coherence tomography (OCT) images. Here three diseases, viz. diabetic macular edema (DME), choroidal neovascularization (CNV), and drusen are considered. These diseases are classified using six different convolutional neural network (CNN) architectures and a comparison has been drawn in terms of accuracy, precision, F-measure and recall. The CNN architectures used are coupled with or without transfer learning. The designed models are found to identify the specific disease or no pathology when fed with multiple retinal images of various diseases. The training accuracies obtained for the different CNN architectures viz., four-convolutional layer deep CNNs, Google's Inception v3 and v4 with transfer learning and VGG (VGG-16 and VGG-19) with transfer learning are 87.15%, 91.40%, 93.32%, 85.31% and 83.63% respectively; while the corresponding validation accuracies are 73.68%, 88.40%, 86.95%, 85.30% and 79.50%.

Another application of deep learning in healthcare is depicted in the form of detection of gastro-intestinal (GI) tract diseases using Wireless Capsule Endoscopy (WCE) images. Here, a well-defined methodology for the detection of eight classes of diseases viz., Vascular Ectasia, Tapeworm, Crohn's disease, Erosion, Esophagitis, Polyp, Ulcerative-Colitis as well as Normal case is proposed. Leveraging the power of Deep Neural Networks, the approach combines Generative Adversarial Networks (GANs) for image augmentation and Auto-Encoder for feature extraction. Furthermore, an attention-based CNN is employed for accurate classification of different disease classes. To enhance the detection performance, the classified outputs are further refined using a Faster Region-Based CNN architecture. The resulting hybridized framework, Encoder-Attention DeepNet, exhibits outstanding performance achieving a remarkable classification accuracy of 98.80% with an Intersection over Union (IoU) score of 0.9 as compared to existing architectures.

In recent years, computer vision is found to have wide applications in maritime surveillance with its sophisticated algorithms and advanced architecture. Automatic ship detection with computer vision techniques provide an efficient means to monitor as well as track ships in water bodies. In this thesis, a deep learning based model capable enough to classify between ships and no-ships as well as to localize ships in the original images using bounding box technique is proposed. Furthermore, classified ships are again segmented with deep learning based auto-encoder model. The proposed model, in terms of classification, provides successful results generating 99.5% and 99.2% validation and training accuracy respectively. The auto-encoder model also produces 85.1% and 84.2% validation and training accuracies. Moreover the IoU metric of the segmented images is found to be of 0.77 value. The experimental results reveal that the model is accurate and can be implemented for automatic ship detection in water bodies considering remote sensing satellite images as input to the computer vision system.

Farm production is an area which requires various resources, labor, money and time for best result. Now-a-day's farm production is becoming digital, and AI is emerging in this field as a very productive tool for farmers and horticulturist in increasing yield of crops and vegetables. Farm production is applying AI as agriculture robotics, solid and crop monitoring, predictive analysis, pest and plant disease control and for various other applications.

Computer vision finds wide range of applications in fruit processing industries, allowing the tasks to be done with automation. Classification of fruit's quality and thereby gradation of the same is very important for the industry manufacture unit for production of best quality finished food products and the finest quality of the raw fruits to be sellable in the market. In the thesis, detection of rotten or fresh apple has been accomplished based on the defects present on the peel of the fruit. The work proposes a semantic segmentation of the rotten portion present in the apple's RGB image based on deep learning architecture. UNet and a modified version of it, the Enhanced UNet (En-UNet) are implemented for segmentation yielding promising results. The proposed En-UNet model generated enhanced outputs than UNet with training and validation accuracies of 97.46% and 97.54% respectively while UNet as the base architecture attaining an accuracy of 95.36%. The best mean IoU score under a threshold of 0.95 attained by En-UNet is 0.866 while that of UNet is 0.66. The experimental results show that the proposed model is a better one to be used for segmentation, detection and categorization of the rotten or fresh apples in real time.

Also the advancement of Deep Learning and Computer Vision in the field of agriculture has been found to be an effective tool in detecting harmful plant diseases. Classification and detection of healthy and diseased crops play a very crucial role in determining the rate and quality of production. Thus the presented work in the thesis highlights a well-proposed novel method of detecting Tomato leaf diseases using Deep Neural Networks to strengthen agro-based industries. The present novel framework is utilized with a combination of classical Machine Learning model Principal Component Analysis (PCA) and a customized Deep Neural Network which has been named as PCA DeepNet. The hybridized framework also consists of GAN for obtaining a good mixture of datasets. The detection is carried out using F-RCNN. The overall work generated a classification accuracy of 99.60% with an average precision of 98.55%; giving a promising IoU score of 0.95 in detection. Thus the presented work outperforms any other reported state-of-the-art architectures.