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Liver Cancer Segmentation and Detection in CT-Scan using CNN

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Abstract: An unnatural increase of cells in the liver, an essential organ of the body, is called liver cancer, a dangerous disorder. A successful course of treatment for this cancer depends on early detection. Nonetheless, because symptoms could not appear until later on, it's frequently difficult to identify it early. A computerized project was created to help detect liver cancer early in order to address this issue. It does this by initially using CT scans to capture pictures of the liver. Then image is resized into required form and a noise in the image is reduced using some technic. Next, in order to extract significant features from the photos, the project employs Feature Extraction and extract some features such as color texture edges smoothness area and size. See it as similar to picking

Keywords: Convolutional Neural Network, CT-Scan, Convolutional layer, Pooling Layer, ReLu Layer, Fully Connected Layer, SoftMax Function.

I. INTRODUCTION

One major global health concern is liver cancer, which includes hepatocellular carcinoma (HCC). It is caused by aberrant cell division that results in hepatic tumour development. For malignant tumours to be effectively treated, early detection is essential. On the other hand, liver lesion segmentation from CT scans by hand is difficult and time-consuming. Automating this process now requires the use of digital image processing tools. Liver cancer can be accurately detected and diagnosed by medical professionals by picture preprocessing, feature extraction, and application of pattern recognition and classification algorithms. This method allows for early intervention, which decreases the need for invasive treatments and enhances patient outcomes.

II. LITERATURE SURVEY

[1] Xin Dong, Yizhao, Zhou Lantian Wang, Yiqun Fan, proposed a project titled "Liver Cancer detection using hybridized fully convolutional neural network based on deep learning framework" in the year 2020. Although manually finding malignant tissue in the liver requires a great deal of time and work, liver cancer is one of the leading causes of mortality worldwide. In order to address this, the research proposes the use of a novel approach for liver tumour detection in CT scans: the Hybridized Fully Convolutional Neural Network (HFCNN). Similar to an intelligent computer program that has been trained to identify various regions of an image—in this case, liver scans—this network is capable of identifying malignant regions. Doctors can use this network to monitor treatment outcomes over time, better design treatment regimens, assess the extent of liver cancer, and forecast patient outcomes. It is, thus, a useful tool for researching liver cancer and refining current treatment methods.

[2] Piyush Kumar Shukla, Mohammed Zakariah, Wesam Atef Hatamleh, Hussam Tarazi, and Basant Tiwari, proposed a project in the year 2020 titled "AI-DRIVEN Novel Approach for Liver Cancer Screening and Prediction Using Cascaded Fully Convolutional Neural Network". The proposed approach looks for lesions and cancers of the liver automatically in abdominal MRI pictures. It accomplishes this by utilizing specialized methods to examine the liver's characteristics and form in the images. One method of doing this ensures that the liver surface can be appropriately understood by the system, regardless of its curvature or unevenness. For correct analysis, it is crucial to establish a consistent model of the liver's surface, which is facilitated by this. Using a technique known as geodesic active contour analysis, the system initially concentrates on separating the liver region from the rest of the body. In this manner, it can focus on the liver in particular and identify any aberrant spots that could point to lesions or tumours

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[3] R Aarthi, S Nivetha, P Vikashini, Dr V.T. Balamurugan, proposed a project titled “Liver Cancer Detection Using Image Processing” Hepatocellular Carcinoma (HCC) is the most prevalent type of liver cancer, which is sometimes referred to as hepatic cancer. Liver cancer is caused by abnormal cell development in the liver. It is difficult to identify this cancer at an early stage, and when it is discovered at an advanced stage, it frequently poses a serious threat to life. Through the use of image processing techniques—more specifically, the analysis of Computed Tomography (CT) images—this study seeks to identify liver cancer early. The procedure entails applying filters to improve the images, which are then segmented using basic morphological techniques to emphasize the tumour regions, such as dilatation and erosion. The intention is to facilitate the early detection and treatment of liver cancers by physicians, potentially saving lives.

[4] S Faiza Nasim, Sana Fatima, Umm E Kulsoom, proposed a project titled “Liver Cancer Detection and Automatic Liver Segmentation by power of AI” in the year 2023. In this experiment, researchers are using artificial intelligence (AI) algorithms to analyse images of liver masses generated by the hepatitis C virus in an effort to detect liver cancer early. These AI systems resemble intelligent computer programs that pick-up knowledge from examples. Their ability to diagnose cancer on par with or even more accurately than human doctors is the subject of ongoing testing. Through a hybrid deep learning and reinforcement learning approach, the researchers aim to improve the accuracy and speed of cancer diagnosis. In the end, earlier disease detection and better care delivery are intended to enhance treatment outcomes for patients with liver cancer.

[5] Mrs. A. Selvarani M. E. Babu Sajish2, M. Pramod, proposed a project titled “Liver Cancer Detection Using ML Classifiers” in the year 2023. Though it can suffer from many disorders, the liver is essential for living. Though manually processing CT pictures is difficult and unfeasible for huge datasets, CT scans are useful for biopsies and for planning radiation treatments for malignancies. Using fuzzy C Means clustering to isolate tumour spots after first removing the liver from CT scans, this research automates the process. These tumour regions provide textural and statistical data that are collected utilizing specialized methods. It calculates and stores features like as variance, average, and unpredictability. To assess whether liver tumour illness is present and to categorize it as malignant, benign, or absent, these features are ultimately fed into an Extreme Machine Learning classifier. This approach seeks to enhance patient care and expedite diagnosis.

III. SYSTEM ARCHITECTURE

An example of a Deep Neural Network (DNN) with exceptional image analysis capabilities is a Deep Convolutional Neural Network (CNN). It includes multiple layers, including pooling, convolutional, RELU, and fully connected layers. Important features from the input photos are learned by the network with the aid of the convolutional layer. In this layer, speed is improved and memory is saved by having CNNs share weights. A CNN can learn features locally because each neuron is connected to a little portion of the input image. The convolutional layer uses learnt filters to combine various regions of the input image into a feature map. To enhance learning, the RELU layer gives the feature map a non-linear function.

Convolution and pooling layers when combined produce a large sample size reduction in Convolutional Neural Network (CNN) architecture, increasing the network's efficiency even further. To facilitate additional processing, conventional Fully-Connected (FC) layers are occasionally added at the output stage. Peak pooling and mean pooling are the two primary functions of the pooling layer. Average pooling is a technique that preserves background information and minimizes errors resulting from small neighbourhoods by calculating the average value of nearby locations. While max pooling chooses the maximum value among a group of nearby points, it helps preserve more texture information and lessens errors in the convolution layer parameter estimate that result from mean deviation. The efficacy of the CNN's image processing and analysis is improved by these coupled functions

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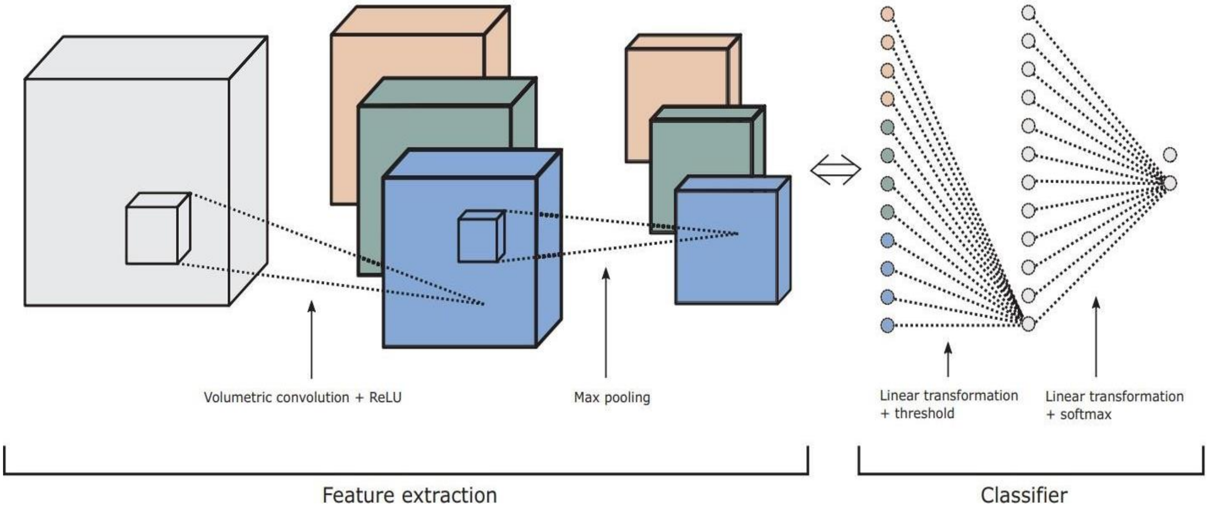

Figure 1: Convolutional Neural Network

IV. IMPLEMENTATION

1) Data Collection: The first step in this Architecture is data collection. The data is collected using Liver Database Consortium (LIDC) and there are 2562 number of train dataset and 584 number of test dataset. Which is saved in the jpg and png format. The Maximum size of the CT scan image taken is 250X250

2) Pre-Processing: The second step is pre-processing, In this stage If the taken image is in RGB format then it is converted into Grey type image. If the image is already Grey image then the pre-processing will the read the given image. The given image is resized into required form. Here it is resized into 50X50 image this process is called as Image Generator

3) Feature Extraction: The Pre-processed image is given to Feature Extraction which is most important step in this process. Features that are extracted from the image are colour, texture, edges, smoothness, area and size. The Feature extraction is done in several steps using layers in Convolutional neural network they are

   - Convolutional Layer- In convolutional layer the input image is of 5X5 matrix. And kernel filter of size 3X3 matrix these two matrices are multiplied and give the output which is of size 3X3 matrix
   - ReLu Layer- The output from the convolutional layer is given into ReLu layer which is used to remove the background noise present in the image
   - Pooling layer- There are two types of pooling layer available they are Max Pooling and Average Pooling. In this we make use of Max Pooling. The image from ReLu layer which is of 3X3 matrix is converted into 2X2 matrix with the help of Max Polling Technic
   - Fully Connected Layer- In this layer the output from the pooling layer is finally converted into 1X4 flatten matrix

4) Classification- In this step the flatten matrix is given into SoftMax function to find out the name of the classification

5) Prediction Interface-The output from this Processes are Data, Meta, Index which are machine values and the Logs which is graphs. And it identifies whether image contain Hepatitis A or B, or Caroli, or cancer or normal cell. So overall performance of this process is that 5X5 matrix is converted into 1X1 flatten matrix and classifies whether the feature extracted CT image contains cancer cells or normal cells

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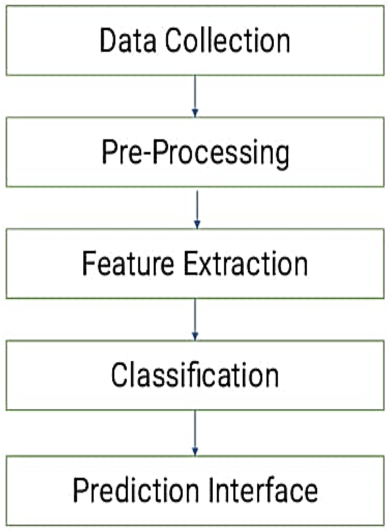

Fig 2. Dataflow Diagram

V. PROPOSED SYSTEM

This project proposes using Convolutional Neural Networks (CNNs) to detect cancer. It involves three main phases: processing, pre-processing, and detection. In the processing phase, wavelets are applied to highlight areas of interest, aiding in tumor segmentation to distinguish between normal and abnormal tissue. Accurately pinpointing the size and location of tumors is crucial for diagnosis. The method consists of four stages: image pre-processing, feature extraction, and classification. In the final stage, CNNs are utilized to classify whether the tissue is normal or abnormal. The aim is to create an efficient algorithm for tumor detection, ultimately improving the accuracy of cancer diagnosis.

1. Data set- Two sources provided the training dataset: the Image Database Resource Initiative (IDRI) and the Liver Database Consortium (LIDC). A total of one thousand comprehensive photos of the liver, including both tiny and large tumours, are present in these databases. Digital Imaging and Communications in Medicine (DI-COM), a format that is frequently used for medical pictures, is where these scans are kept. Researchers can enhance the diagnosis and course of therapy for liver cancer by utilizing this dataset to train algorithms to identify and assess liver cancers in CT scans.

2. Image segmentation- Photographic segmentation can be compared to tearing a picture into smaller pieces. This makes it easier to distinguish between various image elements, such as objects or the lines dividing them. Making the image easier to comprehend and analyse is the primary objective of segmentation. We can more easily observe and comprehend the image by breaking it up into separate sections. Through this procedure, the visual interpretation becomes simpler, resulting in a clearer and faster analysis.
3. Pre-Processing- We apply a median filter in the preprocessing phase to enhance the calibre of the test image. Any distortions that might have happened during the picture collecting process are less noticeable with the use of this filter. Various methods are explored for preparing the image for additional analysis in the context of lung nodule analysis. In order for the median filter to function, the value of each pixel is substituted with the median value of all of its nearby pixels, including itself. This implies that every pixel value that deviates noticeably from its neighbours will have its value changed to better align with the surrounding values. The outcome is a smoother and more manageable image, which can improve the precision of later stages of analysis.

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VI. RESULTS

Fig 3. User Login Portal

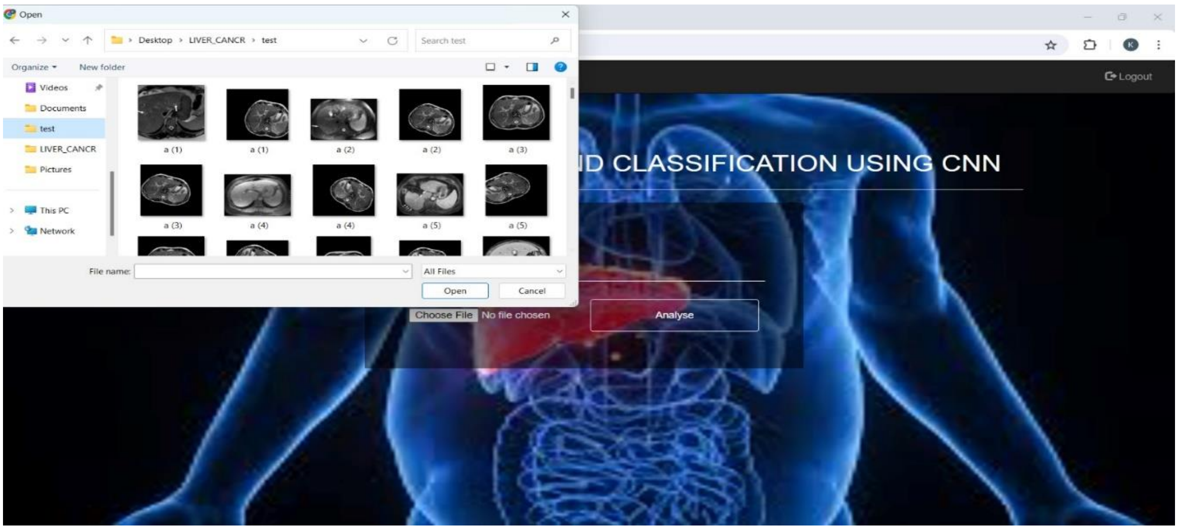

Fig 4. Selecting of CT scan image

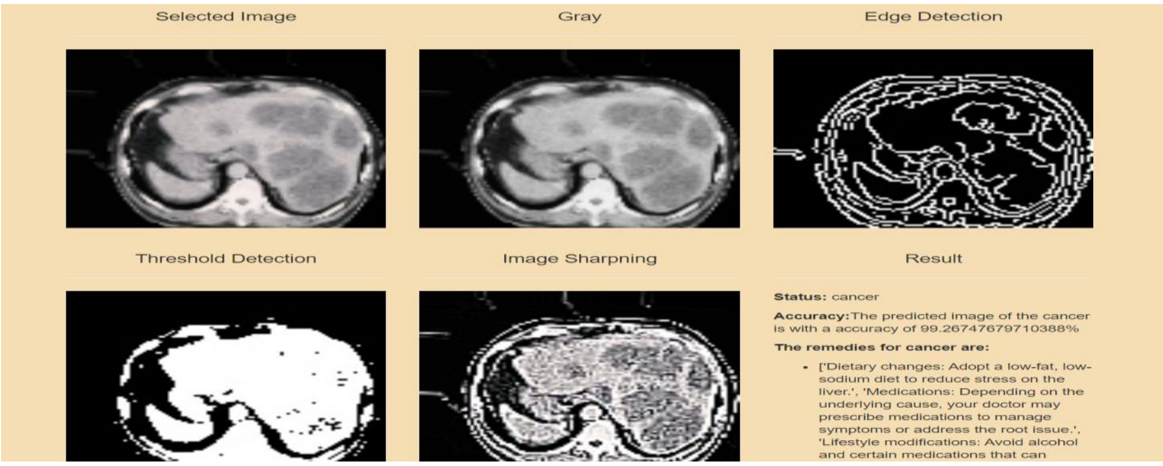

Fig 5. Final Output

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Fig 6. Normal Liver CT Scan Image

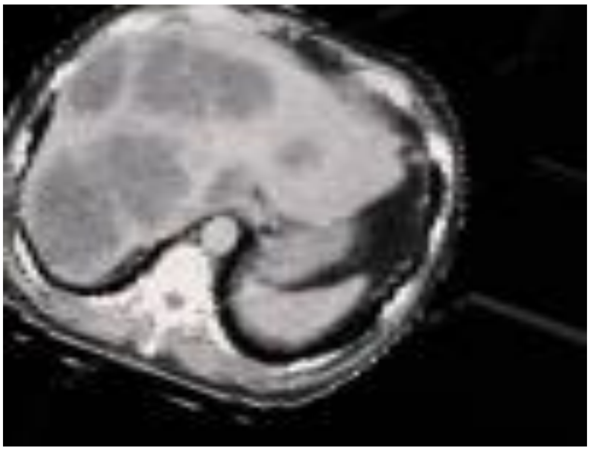

Fig 7. CT Scan Image with liver cancer

VI. CONCLUSION

In order to identify and classify liver cancer and lesions in medical images, this research presents the Hybridized Fully Convolutional Neural Network (HFCNN) technique. To improve detection accuracy, the neural network extracts features from these photos using many layers. The technique provides effective tumour segmentation and exact measurements of liver volume with a high average Dice coefficient of 0.92 by merging 2D feature maps with several image slices. Convolutional Neural Networks (CNNs) trained to detect tumours and healthy regions in liver pictures are used in this study. The tumour voxels are then classified by segmentation. To get accurate findings in the end, segmentation leaks are fixed. A promising strategy for medical diagnosis and therapy, the suggested HFCNN method shows great accuracy in recognizing liver cancers despite minimal testing.

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