Automated segmentation of focal liver segment on CT scan using machine learning based on ANN

[1]Priyadharshini.M, [2]Mohanapriya.T, [3]Sirajudeen.H, [4]Angayarkanni.N

Paavai Engineering College
Pachal, Namakkal.

***Abstract*- This project is based on deep machine learning to perform automatic segmentation of liver cancer cases depicted in computed tomography (CT) images. The segmentation results obtained through this approach were then compared to those generated using atlas-based automatic segmentation. A U-Net neural network with an encoder-decoder architecture was developed. The deep ANN (Artificial Neural Network) that underwent training successfully conducted automatic segmentation of CT images for 36 instances of liver cancer.**

***Keywords*- ESP8266, ANN, Arduino Uno, Python Software, GSM/GPS module.**

I. INTRODUCTION

The subdivision of the human liver into anatomical regions is a regular task for radiologists, particularly when it comes to accurately localizing focal liver lesions before surgery. The choice of hepatectomy is largely based on the segmental localization of the lesion. Additionally, identifying the liver segment is crucial to minimize the risks associated with liver surgery. Due to the heterogeneous nature of certain liver diseases, quantitative parameters like liver fat fraction and value need to be measured at a segment level. Currently, radiologists rely on visual interpretation or manual segmentation, which are time-consuming, labor-intensive, and prone to variations between observers. Therefore, there is a strong demand for an automated liver segment segmentation tool that is practical for clinical use. Over the past two decades, extensive research has been conducted on computer-assisted liver segment segmentation. However, most of these studies have utilized traditional machine learning techniques that do not meet the performance and efficiency requirements for clinical applications. The initial step in this process involves segmenting the hepatic vessels using the skeletonization process, followed by extracting the main direction of the largest vessels to achieve separation of different liver segments. Nevertheless, the entire procedure lasted for over 8 minutes, and achieving satisfactory outcomes heavily relied on precise vascular segmentation. This task proved to be challenging due to the intricate and intertwined vascular anatomy within the liver. In order to address this issue, our team introduced a novel approach based on multiple features. This innovative method significantly enhanced the accuracy of vessel separation and consequently, it was anticipated to enhance the segmentation of liver segments as well. However, the quantitative results pertaining to the segmentation of liver segments were not provided in the aforementioned publication. Additionally, their method required an average of 20.8 seconds per case to obtain liver segments.

Liver diseases can be categorized into three stages: firstly, liver inflammation; secondly, liver scarring (cirrhosis) and finally, liver cancer or failure. These conditions are commonly observed in cases of liver sick

This paper examines the strategies that indicate liver sicknesses at an acceptable degree of accuracy and determines the methods that produce the great accuracy. This examine selects a single facts set of liver sufferers with 5 supervised getting to know techniques which can be applied to that data set in R.

In this paper, the techniques that indicate liver diseases at an acceptable level of accuracy and determines the methods that produce the best accuracy. This study selects a single data set of liver patients with five supervised learning techniques that are applied to that data set in R.

Moreover, our model showcases a remarkable performance in terms of accuracy, dice similarity coefficient, and specificity parameters when compared to established algorithms. Additionally, it exhibits exceptional adaptability across various datasets

II.LITERATURE REVIEW

The research paper focuses on a hierarchical convolutional neural network (CNN) framework that aims to automatically detect and classify focal liver lesions (FLLs) in multi-phasic computed tomography (CT). Diagnostic radiographic imaging techniques, such as dynamic contrast-enhanced computed tomography (CT), offer valuable information for the differential diagnosis of these FLLs.

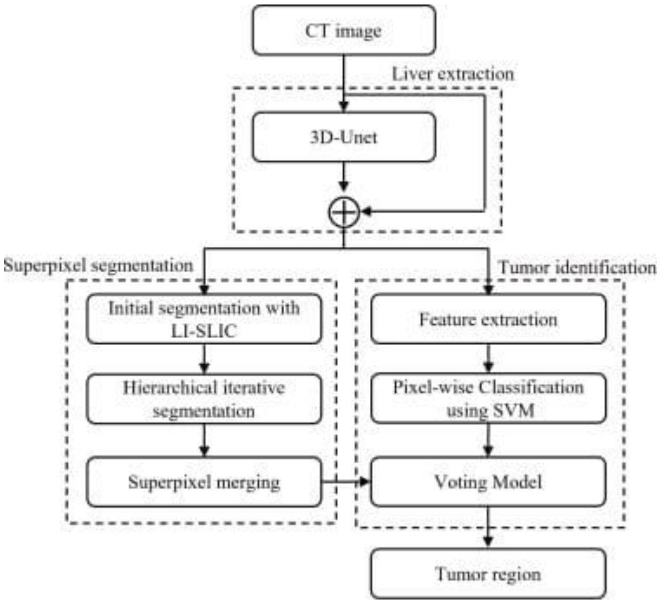

FIGURE 1. BLOCK DIAGRAM OF LIVER SEGMENTATION

This initial investigation showcases the accurate localization and classification of FLLs in a restricted dataset through the implementation of a multi-modality and multi-scale CNN architecture. Deep learning (DL), a burgeoning field within machine learning, enables the automatic extraction and acquisition of features from data through a sophisticated nonlinear process facilitated by a neural network structure.

The incorporation of liver tumor diagnosis ideas was achieved by the researchers through the utilization of convolutional neural networks and various other deep learning systems. It is worth noting that both supervised and unsupervised classification methods were employed. In the supervised system, the feature sets were organized into predefined groups, whereas in the unsupervised method, they were assigned to undefined classes.

Classification algorithms are frequently employed in the prediction of liver disease, as they enable the assessment of whether a patient possesses the ailment or not by analyzing specific features or characteristics.

According to the available solutions, it has been determined that the F-Tree algorithm demonstrates the highest level of accuracy compared to the other algorithms that were tested. This makes it an appropriate option for predicting liver disease. The combination of feature selection and the fuzzy K-means classification methods is widely utilized in the classification of liver diseases.

The performance of these cutting-edge algorithms was assessed in the study, utilizing metrics such as data accuracy, data effectiveness, and correction rate, and subsequently comparing the outcomes.

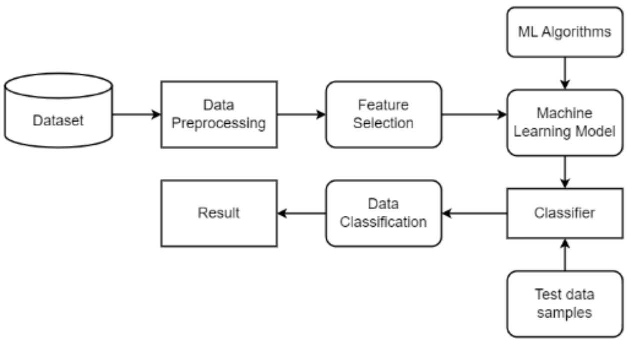

FIGURE 2. PROCESSING OF ML ALGORITHM

We conducted a comprehensive assessment of the model in this research, employing three distinct approaches. Quantitative evaluation yields precise outcomes and enables comparisons across various studies. The DSC metric is commonly employed for this objective. Thus far, the accuracy of liver segment segmentation achieved by previous methods has not surpassed an 88.2% DSC. Subpar segmentation primarily arises in cases with severe vascular issues, such as abnormal vascular routes or vessels heavily infiltrated by tumors. This issue could potentially be resolved by gathering such cases and retraining the model.

The purpose of this research is to verify the effectiveness of a deep learning model in accurately segmenting the liver into different anatomical regions using PVP MRI images. The results of our experiments demonstrate that our model successfully divides the liver MR images into eight distinct regions and remains reliable even when used with various MR scanners.

III. PROPOSED METHODOLOGY

The configuration of the proposed system is to used to predict the disease and other odd factors using algorithms such as classification and clustering. The Deep Learning is also a machine learning technique yet works such better than the later. The clustering algorithms aids in the grouping of the data based on their common properties but the classification algorithms categories the data according to a specific predefined class Prediction of liver Disease using ANN Algorithms" proposed the conventional text-classification deep learning algorithm, ANN has demonstrated significant superiority over genetic and KNN learning algorithms. Therefore, this research focuses on implementing a deep learning algorithm instead of traditional machine learning algorithms. Python's elegant syntax, dynamic typing, and interpreted nature make it an ideal language for scripting and rapid application development across various platforms. The input design aims to control the required input amount, minimize errors, eliminate delays, reduce unnecessary steps, and maintain a simple process.

A encoder-decoder U-Net neural network was developed for automatic segmentation of CT images in 36 cases of Liver cancer using the trained deep ANN (Anti neural network). The Dice similarity coefficient (DSC), mean surface distance (MSD), and 95% Hausdorff distance (95% HD) were calculated and compared with atlas-based segmentation results, using manual segmentation as the standard. The input is designed to prioritize security, ease of use, and privacy retention.

In our proposed system, an alert is triggered through a buzzer and the condition is displayed on an LCD when the disease reaches a critical stage. Additionally, an app suggests hospitals and specialist doctors' names.

The hardware components utilized in this project include the Arduino UNO, which acts as the system's brain, managing control and communication. The ESP8266 is used as an access point, hosting a webserver or connecting to the internet to retrieve or upload data.

As for the software component, Python programming language is employed to develop a deep learning model for segmenting the liver from a public CT scan dataset.

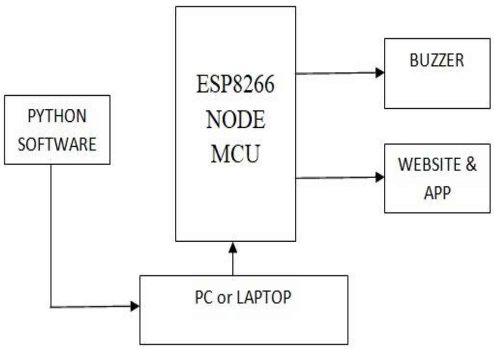

Figure 3. Block diagram of our proposed model

A. ESP8266

The ESP8266 is a wifi SOC (system on a chip) manufactured by Espressif Systems. This highly integrated chip is specifically designed to offer complete internet connectivity in a compact form. On the other hand, the NodeMCU is a microcontroller development board that comes with wifi capability. It utilizes the ESP8266 microcontroller chip.

It has the capability to function as an access point and/or station, serve as a host for a webserver, or establish a connection to the internet for retrieving or uploading data. Additionally, it is a programmable WiFi module with

Arduino-like (software defined) hardware IO. It can be programmed using either the user-friendly and robust Lua programming language or the Arduino IDE.

The Node MCU board generally functions within the voltage range of 3.3V to 5V. It is equipped with WiFi and Bluetooth capabilities, as well as onboard CP2102 and keys. The ESP8266EX microcontroller incorporates a Tensilica L106 32-bit RISC processor, which ensures minimal power consumption and can reach a maximum clock speed of 160 MHz

B. Arduino UNO

The Arduino Uno, released in 2010, is a microcontroller board developed by Arduino.cc. It is based on the Microchip ATmega328P microcontroller and operates on an open-source platform.

With its user-friendly hardware and software, Arduino enables easy interaction with external devices by reading inputs such as light on a sensor. The Arduino Uno can be powered either through a USB connection or an external power supply, with the power source being automatically selected.

C. Buzzer

The buzzer is an electronic device that makes an audible sound when an external voltage is applied. When the condition of the liver exceeds a normal liver conditon, then it will be indicating through the sound of the buzzer.

D. GSM/GPS Module

The SIM808 Bluetooth Compatible GSM/GPS Development Board with GPS Antenna (Arduino) is a versatile development board that allows you to utilize GSM communication and GPS features with your Arduino. By incorporating the SIM808 module, you can easily send and receive SMS messages, track locations, and even create your own cell phone.

The SIM808 module functions as both a GSM communicator and a GPS receiver, providing a convenient two-in-one solution. This module is built on the latest GSM/GPS module SIM808 from SIMCOM, which supports GSM/GPRS Quad-Band network and integrates GPS technology for satellite navigation.

With GPS tracking capabilities, the SIM808 module can accurately determine its location using GPS satellites, making it useful for finding the location of hospitals or other places of interest. Additionally, the GSM communication feature enables connectivity through text messages (SMS) and data transmission, allowing you to send alerts or receive commands remotely.

I**. Python Software**

A Python compiler plays a vital role in the Python programming ecosystem as it converts Python source code, which is readable by humans, into machine code or bytecode at a lower level. Unlike Python interpreters that execute code line by line, compilers produce a compiled code version that has the potential to improve performance.

A compiler is a software application that transforms high-level programming language into a lower-level language that can be comprehended by the assembly and interpreted as logical inputs. Despite being commonly categorized as an interpreted language, Python encompasses various implementation versions such as C Python and Iron Python. C Python, being the standard version, converts code into bytecode, which often leads to the misconception that Python is interpreted.

Nevertheless, the CPU unit cannot comprehend these interpreted codes and thus necessitates an interpreter. Subsequently, the Python Virtual Machine proceeds to transform the bytecode into machine code.

IV. Result

The deep ANN-based and atlas-based techniques demonstrated satisfactory performance for the Liver (with average values of $0.87 < DSC < 0.95$, $1.8 \text{ mm} < MSD < 3.8 \text{ mm}$, and $7.9 \text{ mm} < 95\% \text{ HD} < 11 \text{ mm}$).The app sends an SMS containing information about the patient's liver condition, as well as the name of the doctor and the location of the hospital.

The accuracy of every model is achieved through training the model using the dataset values and evaluating it by predicting the dataset value. The accuracy is determined by the number of accurate predictions made by the model.

IV. CONCLUSION

The implementation of prediction and ANN algorithms using the liver patient data set has effectively alleviated the burden on doctors. Our recommendation is to utilize machine learning techniques for a comprehensive evaluation of the patient's overall liver health.

Hence, the results obtained from the suggested classification model demonstrate a high level of accuracy in forecasting the outcome. Our research focuses on utilizing deep learning methods to anticipate liver disease. To enhance the precision of liver disease prediction and classification models, future endeavors involve incorporating a wider range of data sources. Additionally, combining various machine learning techniques can further enhance the accuracy of liver disease prediction and classification. By training machine learning models with individuals' distinctive attributes, it becomes possible to predict the probability of liver disease occurrence.

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