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Infant Brain Tumor Detection Using Ultrasound

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Abstract: Brain tumours are a serious health danger, and the prognosis of patients is greatly enhanced by early identification. Deep learning techniques have surfaced as a viable method for automated brain tumour identification, utilising artificial intelligence to effectively and precisely analyse medical pictures. The purpose of this work is to investigate the most advanced deep learning methods available today for the detection of brain tumours, including RNN and its variants, and to assess how well they perform over a range of datasets.

Keywords: Recurrent neural network (RNN), Ultrasound, and brain tumor.

I. INTRODUCTION

The primary controller of both sympathetic and parasympathetic nervous system activity is the human brain. The brain is the centre of intelligence, the starting point for physical growth and movement, and the regulator of behaviour. The human brain is the most complicated organ, with over 100 billion nerve cells that synapses allow for communication. The nerve cells called neurons are responsible for transmitting information between the body's organs. The nervous system is mostly controlled by the human brain. Different neurotransmitters offer different neurons a pathway for communication. the channel of communication connecting the dendrites of the subsequent nerve cell to the synapses of the preceding nerve cell. The human brain is in charge of controlling muscular movement, regulating awareness of the surroundings, and regulating body temperature.

The human brain, which is made up of glial cells, blood vessels, and neurons, weighs between 1.3 and 1.4 kg on average. The human brain is divided into four lobes: the temporal, parietal, frontal, and occipital lobes. The cerebral cortex is located in the largest portion of the brain, the cerebrum. As seen in figure 1.1, the other primary coordinating centres of the human brain are the basal ganglia, cerebellum, skull, and spinal cord.

Unwanted, uncoordinated growth of sick or abnormal brain cells is called a brain tumour. A brain tumour raises the intracranial pressure inside the skull, affecting the white matter (WM), grey matter (GM), and cerebrospinal fluid (CSF) regions. The location, size, and kind of a tumour determine its severity, and they can affect any portion of the brain. Cancer cells proliferate uncontrollably and, like healthy ageing bodily cells, they never die. When the number of cells increases and a cyst forms, the tumour keeps growing. There are two kinds of brain tumours: benign and malignant.

Non-cancerous cells that do not penetrate nearby healthy tissues are known as benign tumours. The benign tumors perimeter or periphery is readily visible, and its growth is extremely sluggish. When benign brain tumours strain on delicate brain areas, they can occasionally be fatal. Brain tumours classified as benign can be removed, do not regrow, and do not contain malignant cells in an uncontrollably manner. Seldom does it develop into cancer.

II. RELATED WORK

Research on using ultrasonography to detect brain tumours in infants is ongoing, with the aim of developing a diagnostic technique that is commonly available, safe, and non-invasive. The following relevant work may be of interest to you: Deep Learning Techniques: Scientists are investigating how to analyse ultrasonography pictures and find patterns that differentiate between brain tissue that is healthy and afflicted by tumours using machine learning techniques.

This method has the potential to increase tumour detection efficiency and accuracy. Methods for Image Processing: Pre-processing ultrasonic pictures and enhancing features important for tumour diagnosis are the areas of ongoing research and development.

This can entail applying methods to enhance the quality of the data that machine learning algorithms use, such as segmentation, edge detection, and noise reduction. Multi-Modality Approaches: A few research look into integrating ultrasound with other forms of imaging.

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III. SYSTEM MODULES

3.1 Modules

The system consists of six parts. They're

1. Module for Data Acquisition: The ultrasound pictures of the baby's brain are taken by this module. It consists of an ultrasound machine that creates electrical signals, operates the probe, and displays images, as well as an ultrasound robe that sends and receives ultrasonic waves.
2. Module for Pre-processing Data: This module cleans up noise, artefacts, and other flaws that can impede the detection of tumours from the ultrasound images before analysing them. Pre-processing methods that are frequently used are segmenting the skull, denoising, and filtering.
. Module for Feature Extraction: From the pre-processed ultrasound pictures, this module collects pertinent features that help distinguish between brain tissue impacted by tumours and healthy tissue. These characteristics could be in the form of texture, intensity, or shape qualities.
4. Module for Classification: This module divides the extracted features into two groups: tumour and healthy, using deep learning methods. Convolutional neural networks (CNNs), random forests, and support vector machines (SVMs) are popular classification algorithms used for this purpose.
5. Module on Decision Making: This module determines if a brain tumour is present or absent by interpreting the classification module's findings. It might also reveal details about the location, size, and kind of tumour.
6. Interface Module for Users: An easy-to-use interface for interfacing with the system is provided by this module. Medical practitioners can view ultrasound images, enter patient data, and receive the analysis's findings.

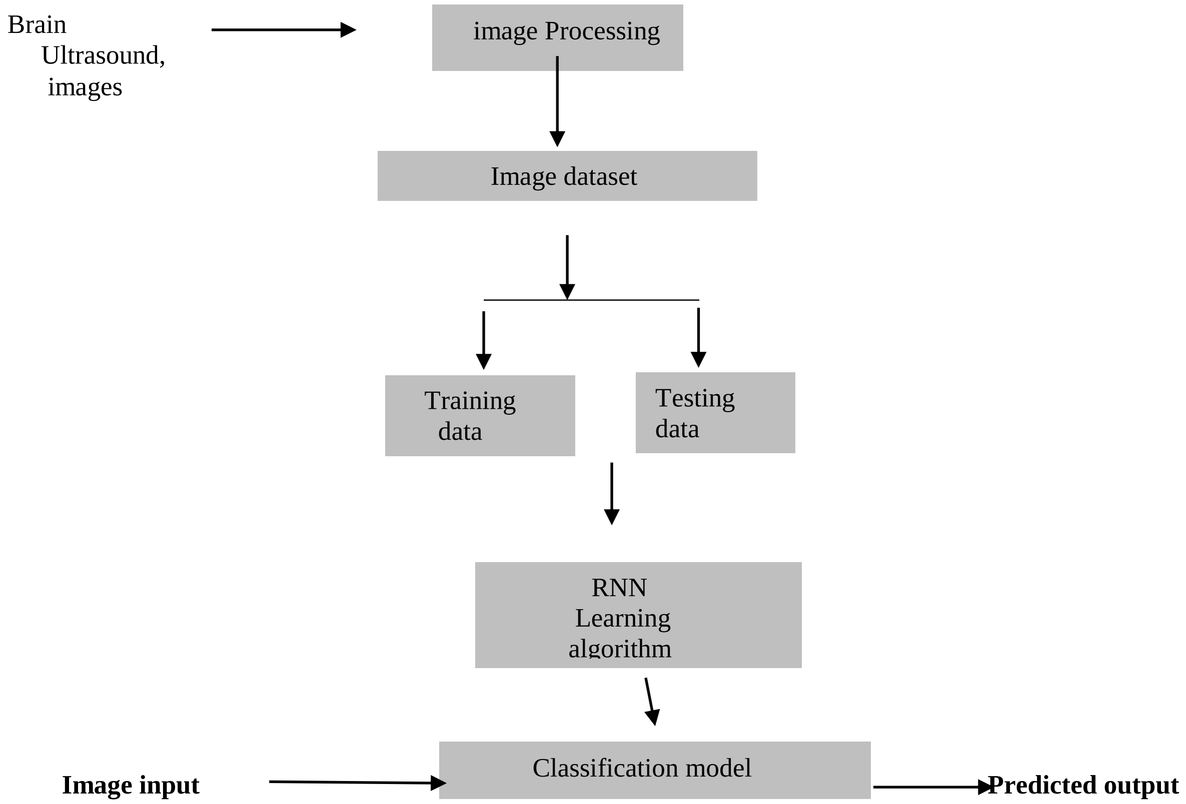

Fig 1: System Design

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3.2. Algorithms & Techniques

Recurrent Neural Networks (RNNs) may be a good choice for an ultrasound-based baby brain tumour detection system. Using RNNs to Identify Brain Tumours: Because RNNs are excellent at processing sequential data, they can be used to analyse time series data. Theoretically, they could examine sets of ultrasonic pictures taken over time to spot alterations that would point to tumours. Problems and Restrictions:

• Static Ultrasound Images: Generally, ultrasound in this application takes one picture at a time rather than continuously capturing sequences. With this kind of data, RNNs might not be able to fully utilise their potential. Data Requirements: For best results, RNNs may need enormous volumes of training data. Due to ethical issues and the rarity of the disorder, obtaining a sizable dataset of labelled ultrasound pictures with proven newborn brain tumours might be difficult.

• There May Be Better Options: At the moment, Convolutional Neural Networks (CNNs) are the most popular option for image processing tasks such as tumour detection in ultrasound pictures. CNNs have demonstrated remarkable success in the domain of image feature extraction, as they are specifically engineered for this purpose.

3.3 RESULTS

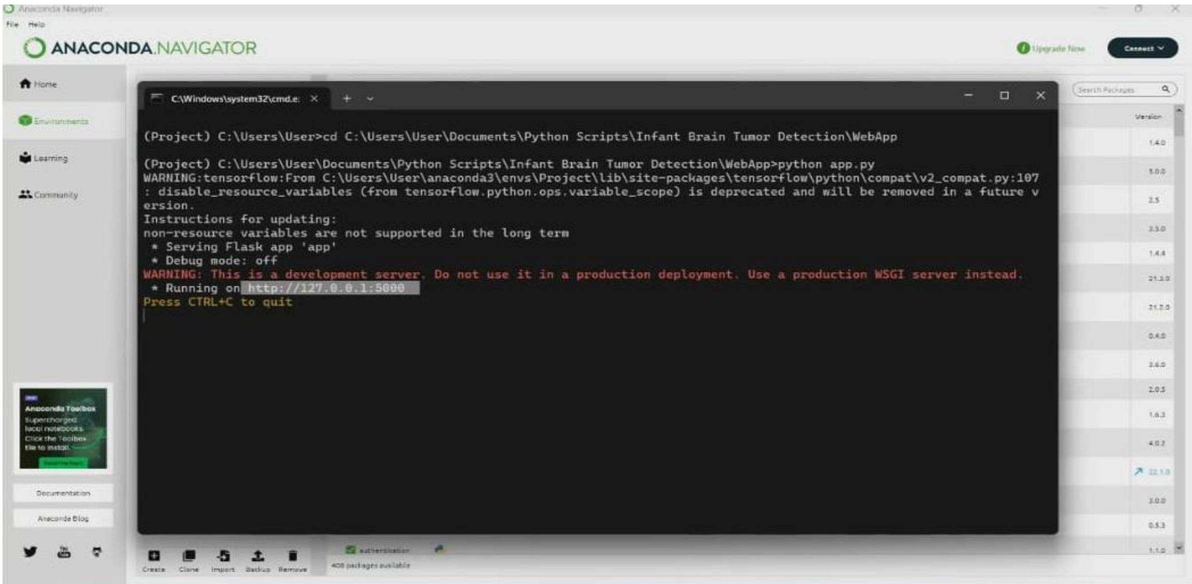

Fig 2: URL page using anaconda navigator prompt

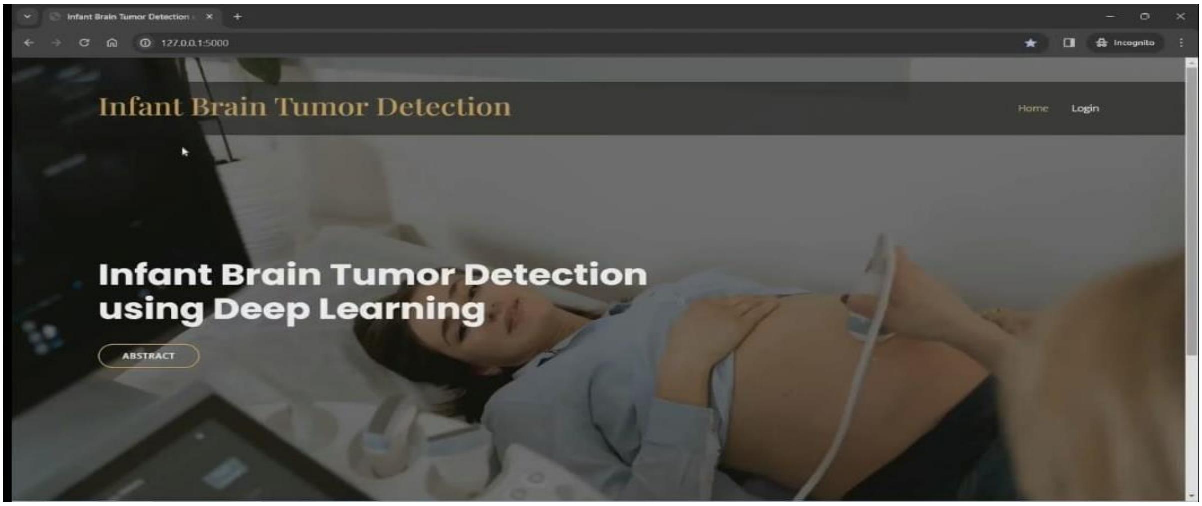

Fig 3: Home page

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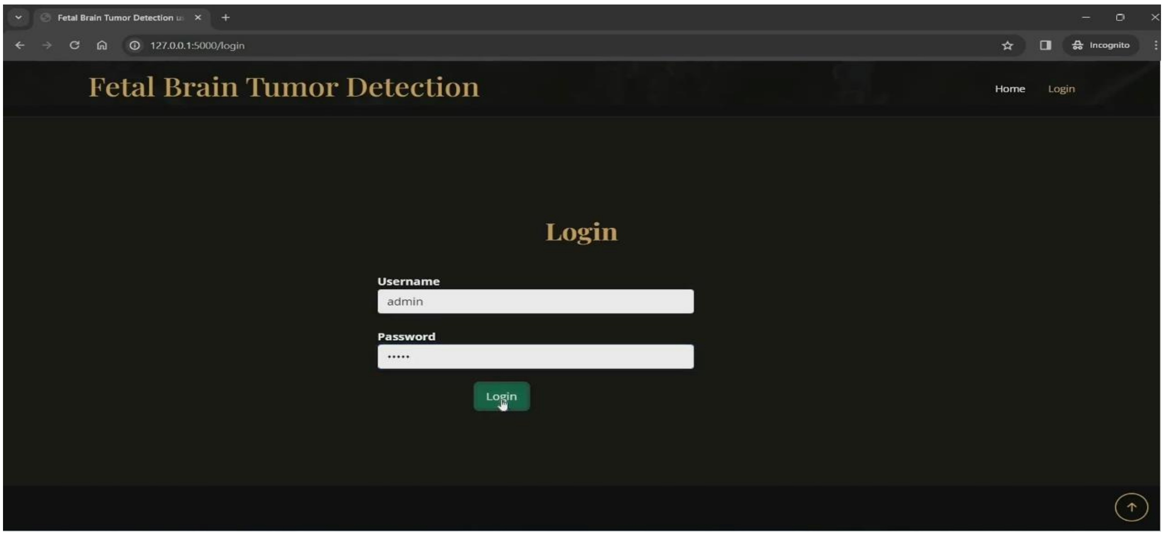

Fig 4: login page

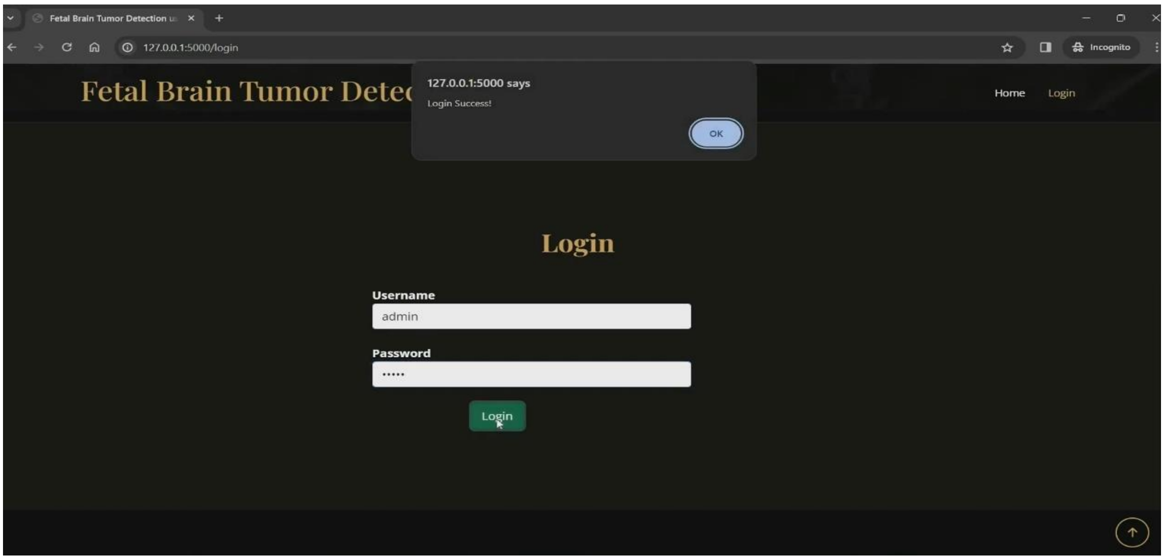

Fig 5: login successfully

Fig 6: choose scan we can upload images

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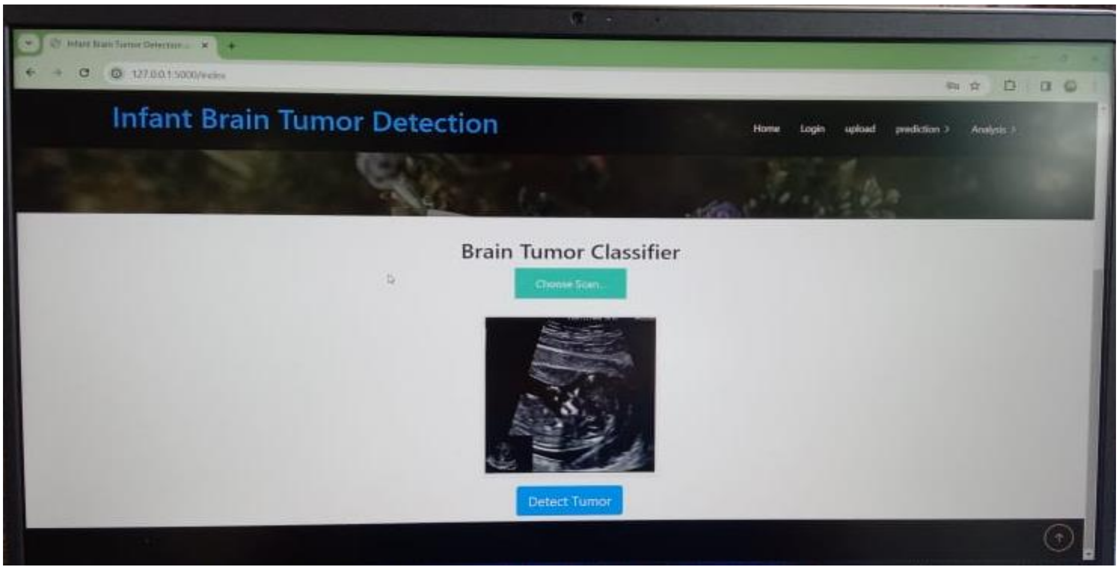

Fig 7: Detect Tumor

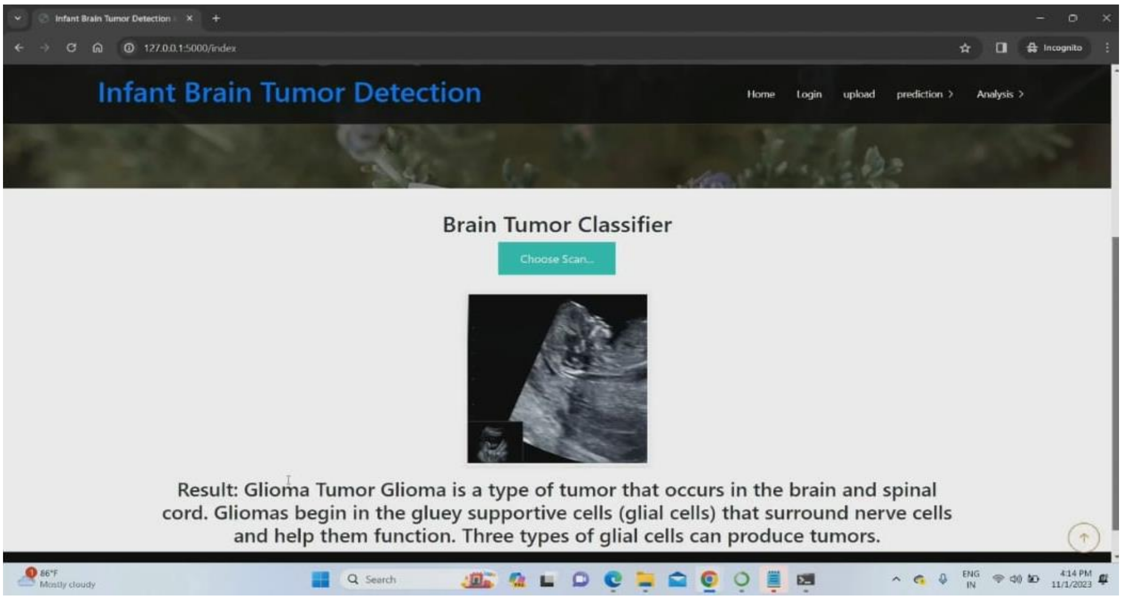

Fig 8: Detect Tumor Type

IV. CONCLUSION

As a convenient, non-invasive method of screening for brain tumours in infants, ultrasound shows promise. Improvements in image processing and machine learning could lead to more accurate tumour diagnosis from ultrasound images. But there are still issues because the images are not as good as an MRI, and more data is required to build reliable diagnosis models. In order to detect new born brain tumours more accurately, further research is being done to improve ultrasound techniques and possibly combine them with other modalities.

V. FUTURE WORK

The use of ultrasonography to detect brain tumours in infants looks promising going forward. As ultrasound technology develops, more precise and high-quality imaging is possible. Researchers are investigating novel methods to better the identification and description of brain tumours in babies, including elastography and contrast-enhanced ultrasonography. Furthermore, the advancement of artificial intelligence systems could facilitate more precise and effective ultrasound picture analysis.

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