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BRAIN TUMOR DETECTION USING MULTI MODAL IMAGE FUSION

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Abstract: In the medical realm, there are different types of modalities and in that computed tomography (CT) and magnetic resonance imaging (MRI), are combined to provide a fused image. Image fusion (IF) is a technique for merging relevant information from different images like MRI and CT of the same part of the body into a single fused image. In this work, brain MRI and CT images are fused together and will be classified as normal or abnormal. If the network is detected as abnormal, the part of the tumor region is detected. This process is done by using Convolutional Neural Network (CNN), You Only Look Once (YOLO) architecture and Image Fusion (IF) techniques. The experimental results are evaluated and give metric values.

IF is a technique which is used for combining data from more than one image to provide much better images than single images. A Convolutional Neural Network (CNN) is a Deep Learning algorithm which can take in fused image and give importance to various aspects in the image. The processing required in a Convolution Neural Network is much lower as compared to other Deep Learning algorithms. The You Only Look Once (YOLO) algorithm is commonly used for real-time object detection. This gives better accuracy for speed-moving objects.

Keywords: Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Image Fusion (IF), Convolutional Neural Network (CNN), You only look once (YOLO)

1. INTRODUCTION:

The major functioning of the body depends on the brain. As we move, think, or do whatever work, everything will be controlled by the brain. In the olden days, problems with the brain occurred, like swelling and brain tumors, and there was no technology present at that time, so the people affected by the brain tumor would be dead, but now the technology has developed in various ways. We get MRI scans to detect brain tumors very effectively, as well as CT scans. The MRI scans use strong magnets and radio waves to create detailed images of the parts inside the body, and these MRI scans are used for soft tissues like muscles, organs, nerves, blood vessels, ligaments, and the brain. The CT scans use X-rays to create cross-sectional images of the body, and these scans are used for dense structures like abnormalities in skeletal structures like bones and for the skull in the head. In this way, the MRI and CT scans came to detect every part that is present inside the body, and here there are other scans like PET and some other scans. Every scan has its own importance, and everything detects different types of images.

There are different types of brain tumors. They are:

Primary brain tumor: These primary brain tumors are created in the brain itself. The origin of these tumors will happen by the cells of the brain or by the tissues of the brain. Like secondary brain tumors, it will not spread from outside parts its origin is brain.

Secondary brain tumors: These secondary brain tumors are not created in the brain; they are spread from somewhere else to the brain, like a tumor from the lungs or from other parts of the brain.

Benign tumors: These tumors grow slowly but are not transferred throughout the body; they will stay in the same place. These will slowly grow, become large, and cause pain. If this type of tumor is present in the brain, it will stay in the brain only. It will not spread across our bodies. These are non-cancerous.

Malignant tumors: These tumors are cancerous because they travel throughout the body. These tumors have cells that grow uncontrollably and spread throughout the body very quickly. This is also considered a secondary brain tumor.

Now, because of the latest technology, doctors know about these tumors, and by verifying them completely, they are telling the patients about the type of tumor they have. If the patient wants to know about the tumor present without the doctor's interference, then artificial intelligence is the technology that helps in this situation. By training the AI model with a deep learning algorithm, it will detect whether the brain tumor is present or not. In the future, let us think about the future. If doctors are replaced by robots, then these types of detection algorithms will be much more useful for robots to detect different diseases. We can use many algorithms to detect diseases, but accuracy is the main factor that should be considered. Here, our project is about brain tumor detection. At last, the project will detect whether a brain tumor is present or not, and we are also considering locating the exact part of the brain tumor and detecting different types of brain tumors. So, the process of doing all this and the results of it are shown in this paper.

2. LITERATURE SURVEY:

Hao Dong [1] in 2017, published a paper on “Automatic Brain Tumor Detection and Segmentation Using U-Net Based Fully Convolutional Networks”. In this paper, Brain Tumor is detected by using U-Net based Fully Convolutional Networks, it was one of the algorithms which was used to detect brain tumors, in this algorithm datasets are taken from the BRATS 2015. In this dataset there are two types: high-grade and low-grade brain tumors. So, by using this data on MRI images, they detected brain tumors. And the Accuracy is not provided.

Mohsena Asharaf [2] in 2019, published a paper on “Brain tumor detection using convolution Neural network”. In this project they trained the Algorithms like Support Vector Machine (SVM), Fuzzy C-Means Clustering, K-Nearest Neighbour. Here based on other algorithms, Support Vector machine (SVM) gives the Accuracy of 92.42% when compared. So here, they said that Support Vector Machine is best for classifying brain tumor than compared to other algorithms.

Parmer Ankita [3] in 2020, published a paper on “Brain tumor detection using deep learning” here the process of the project takes place by using MRI images. These MRI images are given to a Convolution Neural Network (CNN), The Neural network is generally called VGG 16 (Visual Geometry Group). Finally, in this project, output will be displayed as yes if tumor is present, and it says no if tumor is not present. The project accuracy is 85% for the 70 epochs.

Ashna [4] in 2020, done a free open-source project which was posted in GitHub where, the web interface is created by using the flask and in this web interface, it is given to take inputs like MRI and CT for the computer files, so that they can be fused together. Here Image segmentation and Image registration takes place which is used for arranging the images into correct positions to make them fused. So here a button is given by

clicking on that button the fused image is generated. So here we can see how the fused image will increase the quality of the image.

Kavitha Bathe [5] in 2021, published a paper on "Brain tumor detection using deep learning techniques". In this project, MRI images are given to different algorithms like K-Nearest Neighbour, Support Vector Machine (SVM) and Convolutional Neural Network (CNN). When they did the comparison between these algorithms, they found that Convolutional Neural Network accuracy is better compared to other algorithms. Accuracy of 92% compared to other algorithms when they performed CNN.

3. EXISTING METHOD:

Multi-Modal-Image-Fusion-techniques is the existing project which was present on GitHub as an open-source project. Here web interface is given for taking the inputs and generating the fused image. For this project Image registration and Image segmentation takes place so that the input MRI and CT images are combined after the processing of the image. And by using the web page interface we can click on the button provided so that we can get the fused image. So here the quality of the brain images is increased by using the fused images. So, to increase the quality of the image, in my project we used the method of Image fusion.

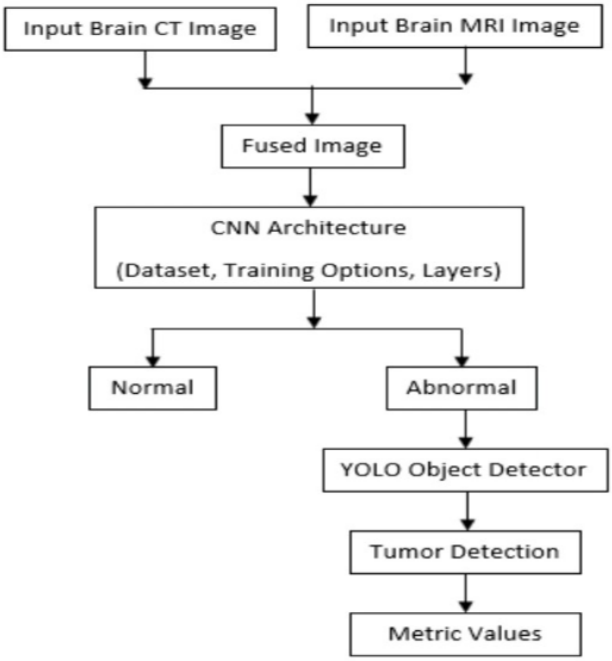
Brain tumor detection using deep learning techniques is the existing project. In this project different types of algorithms are used for detecting brain tumor like K-Nearest Neighbour, Support Vector Machine (SVM) and Convolutional Neural Network (CNN). In this project accuracy of Convolutional Neural Network is more compared to K-Nearest Neighbour, Support Vector Machine (SVM). So, in the implementation of my project, we used CNN for better accuracy results.

4. PROPOSED METHOD:

For developing the project, the first step is to collect the datasets of MRI and CT scans and now we must implement the Image fusion technique to the MRI and CT scan images so we will get the fused images and we must form these fused images as another set. Now train the Convolutional Neural Network by using these fused images dataset. After that training the YOLO algorithm based on the Brain abnormal images to highlight the exact part of brain tumor. By merging all these processes into one and we can see the output in web pages we are developing this project by using python.

The output will be shown in the Webpages which were created by using HTML and CSS and in that webpage, we must take the inputs of MRI and CT images and the fused image will be formed and it was given to the CNN network and the CNN will say that the brain is normal or abnormal. If the brain is abnormal then it was given to the YOLO so that it will detect the exact region of the brain tumor and gives us the metric values.The overall performance gives a 96% accuracy.

5. FLOWCHART:



6. RESULT:

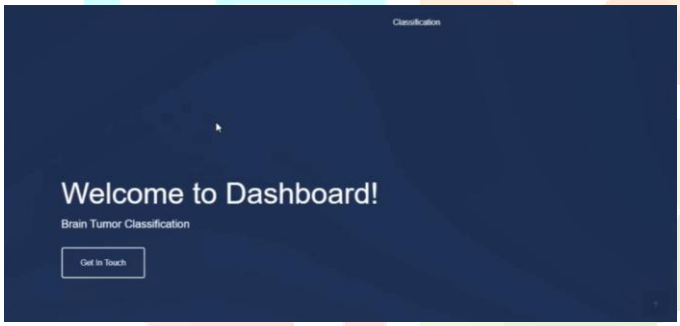


Fig 1: Home Page for Tumor Classification

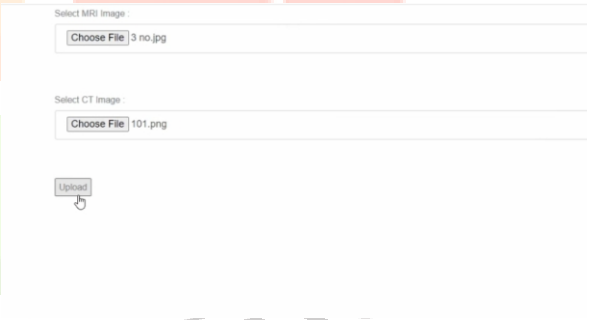


Fig 2: Input MRI and CT images

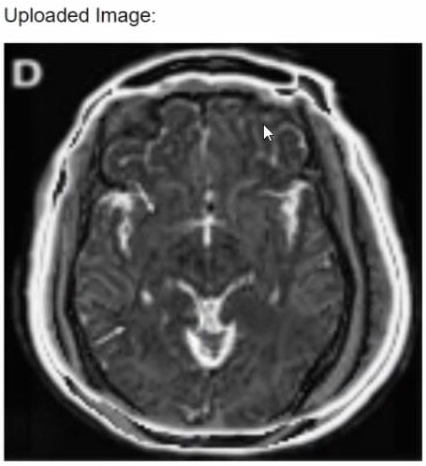


Fig 3: Fused Image without Brain Tumor

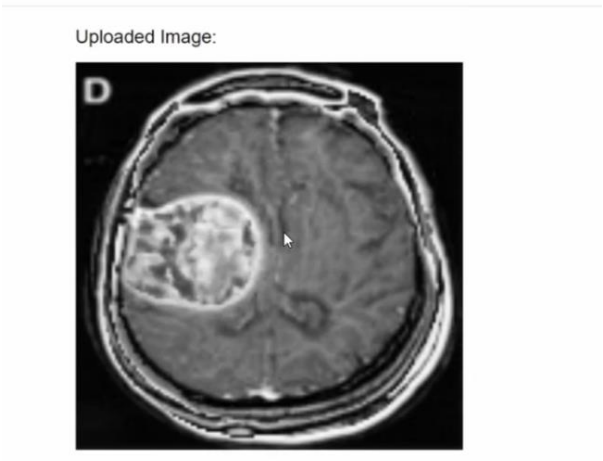


Fig 4: Fused image with Brain Tumor

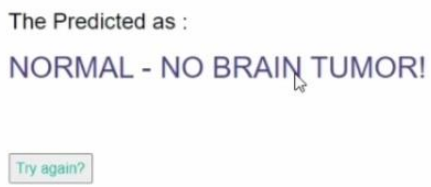


Fig 5: Predicted output for Fig 3

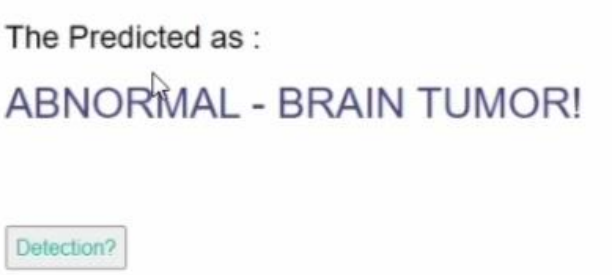


Fig 6: Predicted output for Fig 4

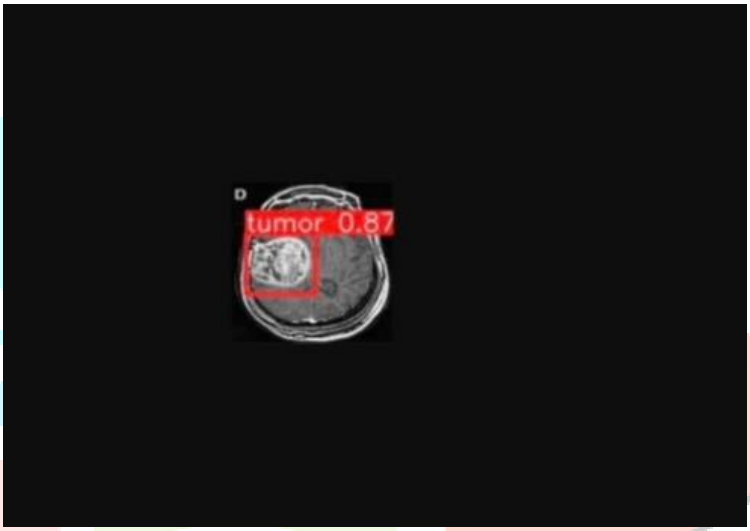


Fig 7: Tumor Region of Fig 4

7. CONCLUSION:

This project is about brain tumor detection using Multi Modal image fusion. From the project title, we can say that this was a combination of different modalities. So, here we are using MRI and CT images for detecting brain tumors. Here, we used two algorithms: Convolutional Neural Network (CNN) and You Only Look Once (YOLO) by using these two algorithms, we detected the brain tumor, and the exact part of the brain tumor was highlighted and provided the metric values. In addition to this, a user-friendly web interface was created to make this project an easy interaction to apply in our daily lives. Here, a link will be provided for the web interface. By using that link, we can easily go to the brain tumor detection webpage, where we can upload the MRI and CT images, and then, after the process, we will get the result with better accuracy. This web interface was created by using the flask in Python libraries. In the future, we can implement more regarding this project.

8. FUTURE SCOPE:

In the future, we can implement this project by combining PET scans with MRI or CT to get a detailed picture. Now, the technologies are increasing day by day, and the performance of the algorithms is also increasing. So, in the future, this project can get much better accuracy using the same algorithms. The latest technology is replacing human work with robots. If we want to replace doctors with robots, then the robots will use these types of algorithms to detect brain tumors. In the future, we will be able to make an app to detect different types of diseases by using this project's user-friendly web interface and the algorithms used. So, if humans have their scanning reports, then they can be able to know their problem by using this developed app.

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