Assistive Diagnostic Tool for Brain Tumor Detection and Segmentation using Computer Vision

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PROBLEM

Today, over 700,000 people are living with brain tumors in the United States.

Brain tumors can spread very quickly to other parts of the brain and the spinal cord

A time-consuming process since it can only be done by radiologists and clinical experts.

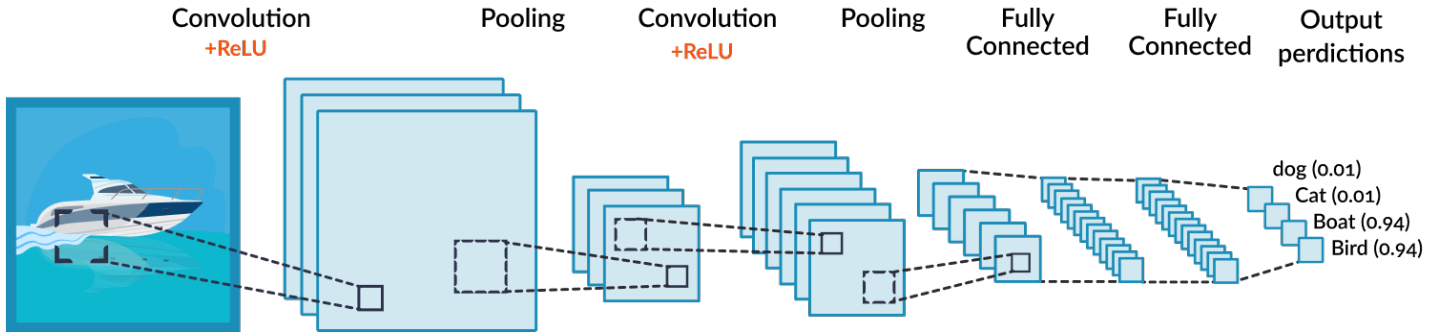
Machine Learning (ML) techniques and Convolutional Neural Networks

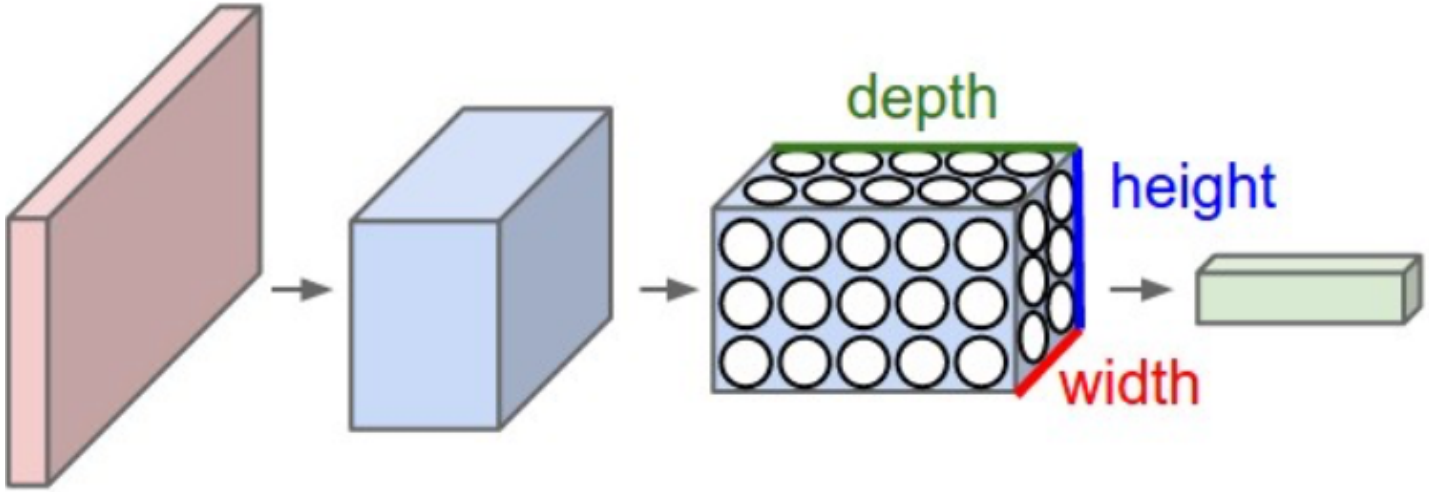
Develop an assistive diagnostic and segmentation tool for brain tumors.

SOLUTION

BACKGROUND

- Computer vision involves developing algorithms to help computers understand the content of digital images or videos.
- Convolutional neural networks (CNNs) are special algorithms designed to take in an image and assign various weights in order to differentiate between images.





”A person”

Image Classification

Semantic Segmentation

Instance Segmentation

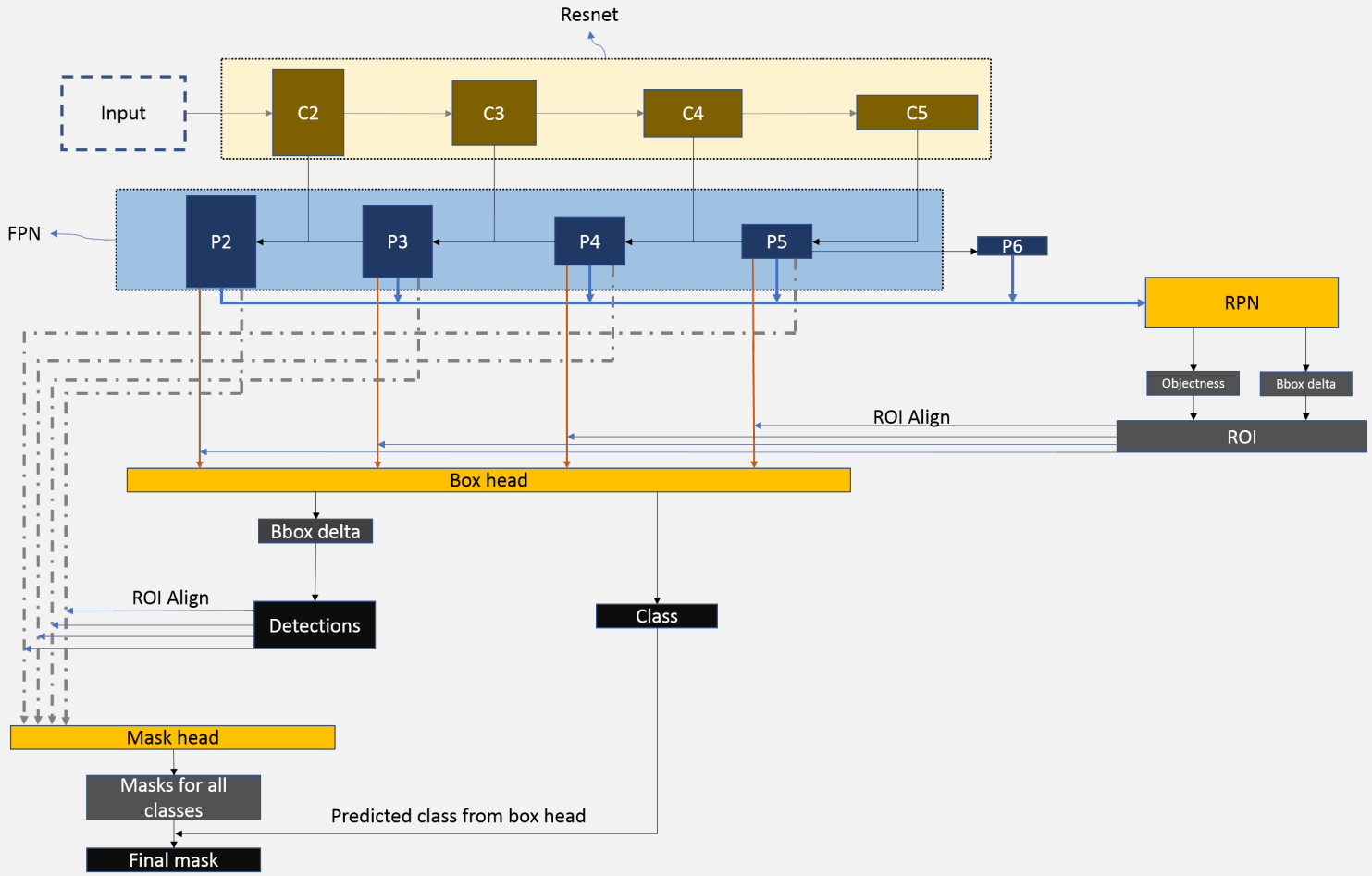
SEGMENTATION

PREVIOUS WORK

- YOLO (You Look Only Once) algorithm, by Joseph Chet Redmon had mAP of 0.57.

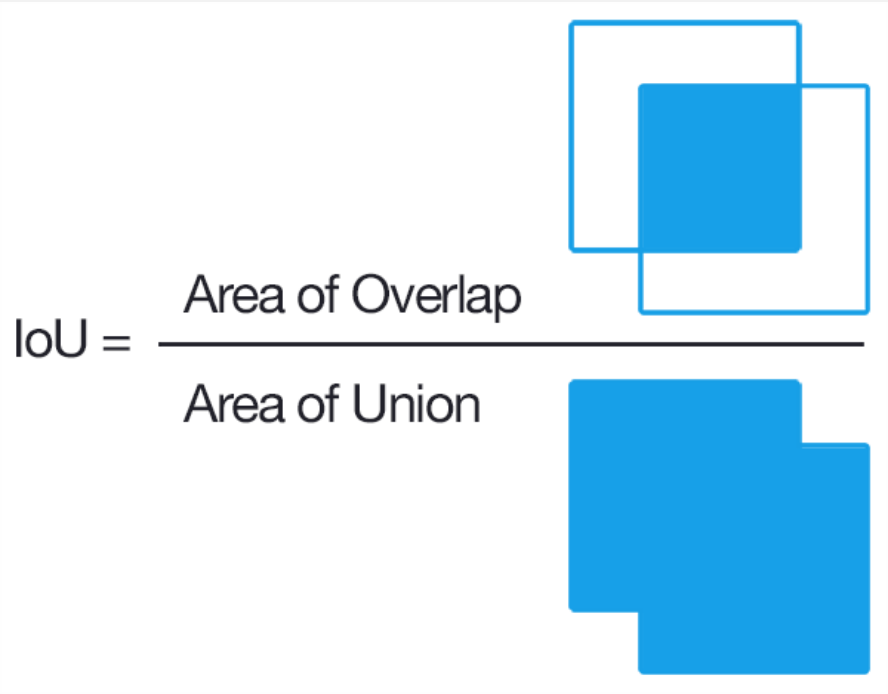
MASK R CNN

- This model's architecture is overlaid and built on top of the Faster R-CNN.
  - extracts attribute maps from the images.
- Maps act as inputs for the Region Proposal Network (RPN) ,
- The RPN predicts if an object is in a certain region, based on annotations
- Process repeated till it finds the object, upon where a mask is drawn



DESIGN CONSTRAINTS

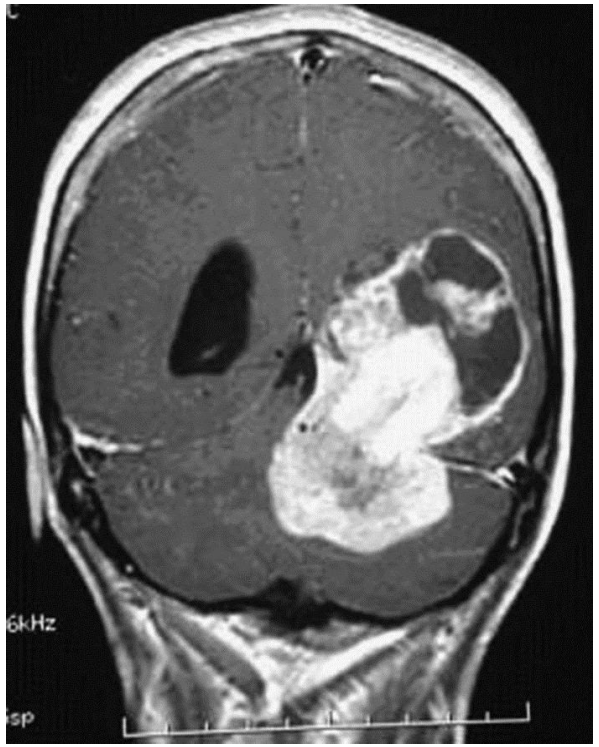
- mAP and IoU score greater than 0.5
- mAP looks at the average precision value for recall value over 0 to 1.
- IoU is area of overlap, over total area.

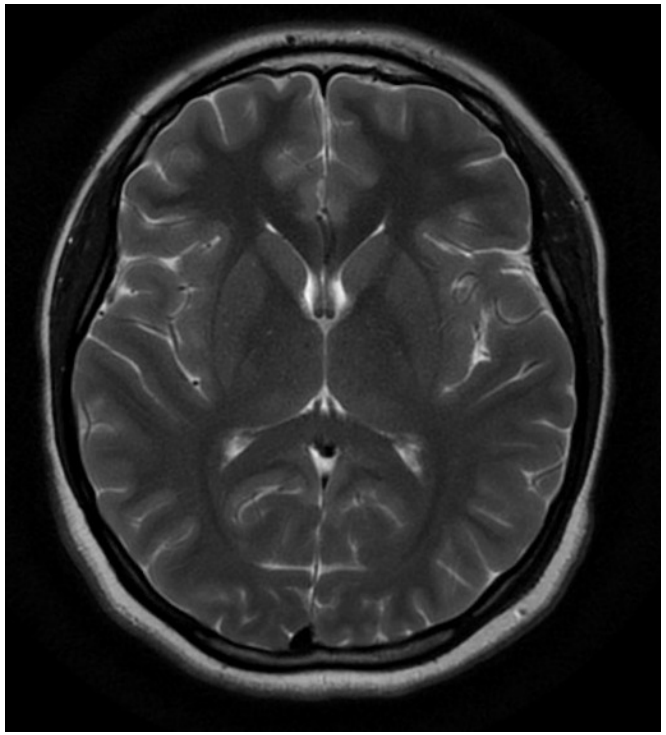


$$\text{mAP} = \frac{1}{N} \sum_{i=1}^{N} \text{AP}_i$$

DATA SET

- A publicly available supervised data set provided by Kaggle was used to train the model. This data set contains a total of 310 images, with 155 in each class (yes and no).





METHODS

1. Google Cloud Services were used to setup a computing engine with a Machine type of "32 vCPUs 120 GB memory", and GPU type of "Nvidia Tesla P100 4 GPU" to train the model.

2. Numpy, Keras, were imported along with the Mask R CNN configuration for transfer learning.

3. Image Augmentation

4. Parameters are changed to match the problem and various methods are implemented

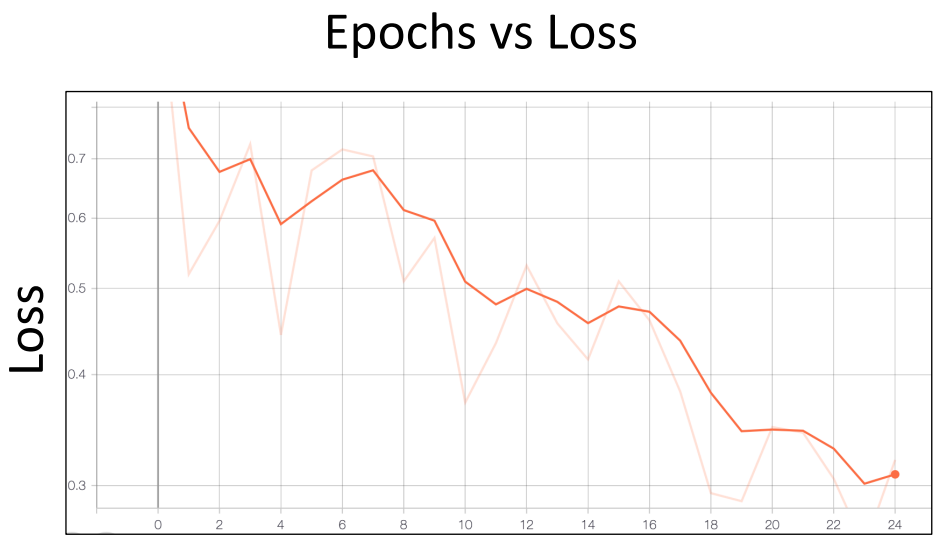
METHODS CONT.

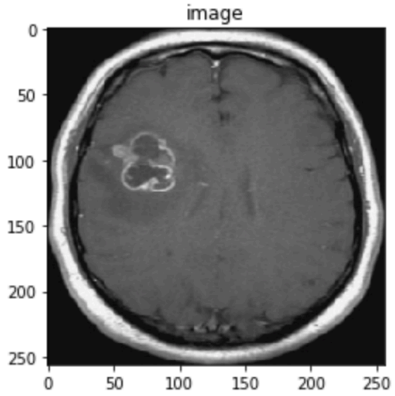
5. Directory, weights and configuration are put together.

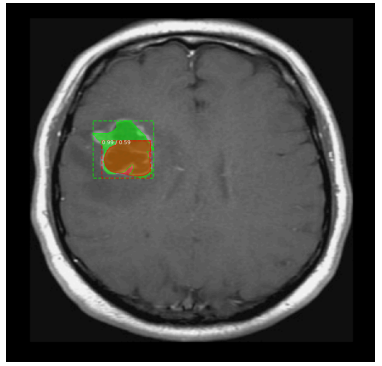
6. The testing and training sets are determined with 60 - 40 split. Model is trained for 20 epochs

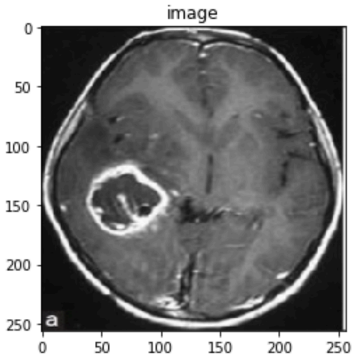
7. Model is first recreated using inference mode. Model is tested and new data is predicted. Finally, the predictions are displayed which includes the segmentation on the image.

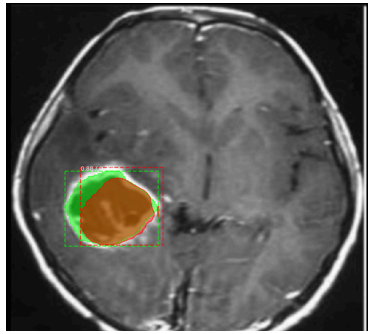
Mean Average Precision Value	0.60
Average Intersection over Union	0.90

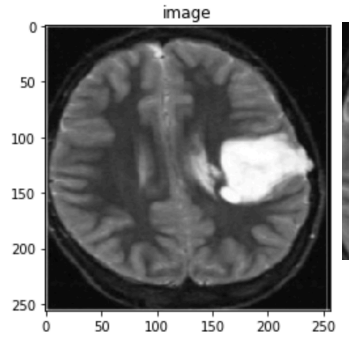


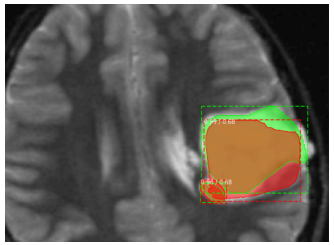








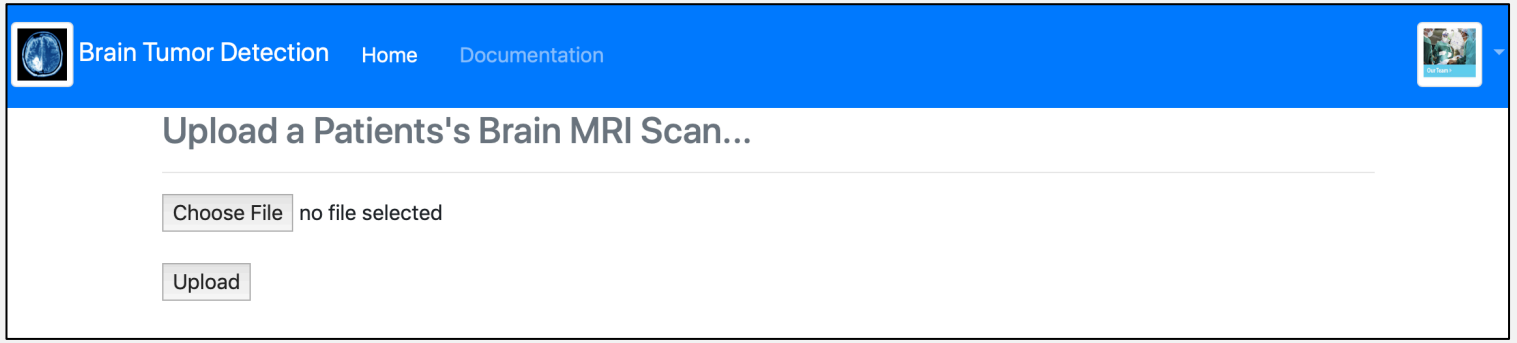


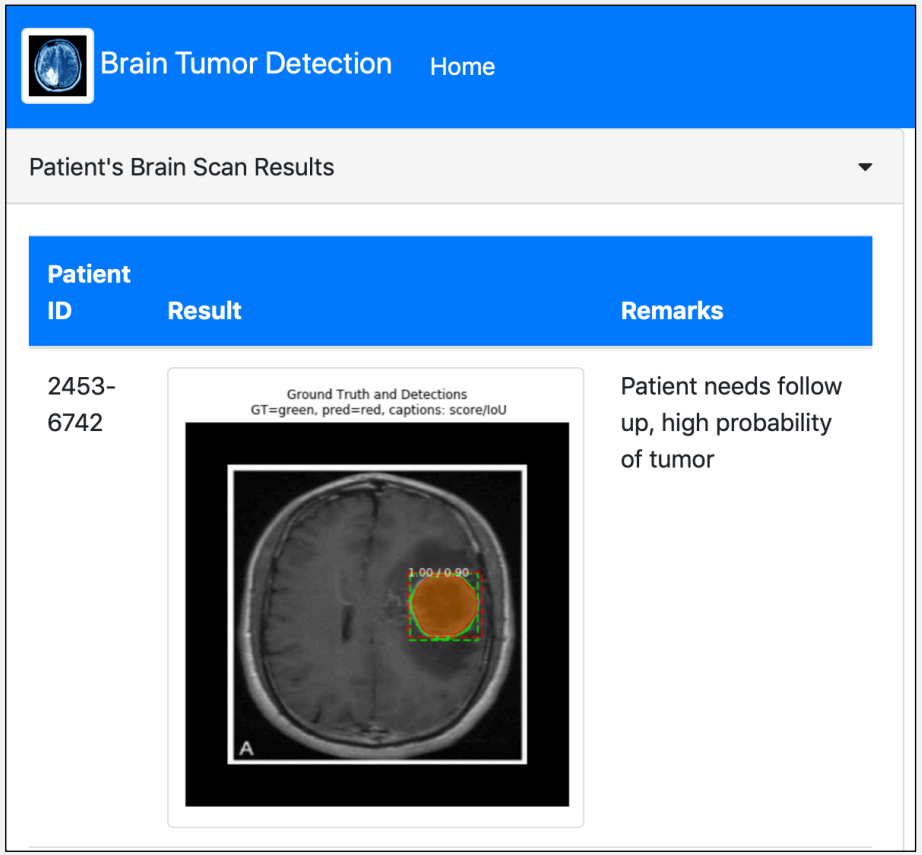


RESULTS

BRAIN TUMOR DETECTION TOOL

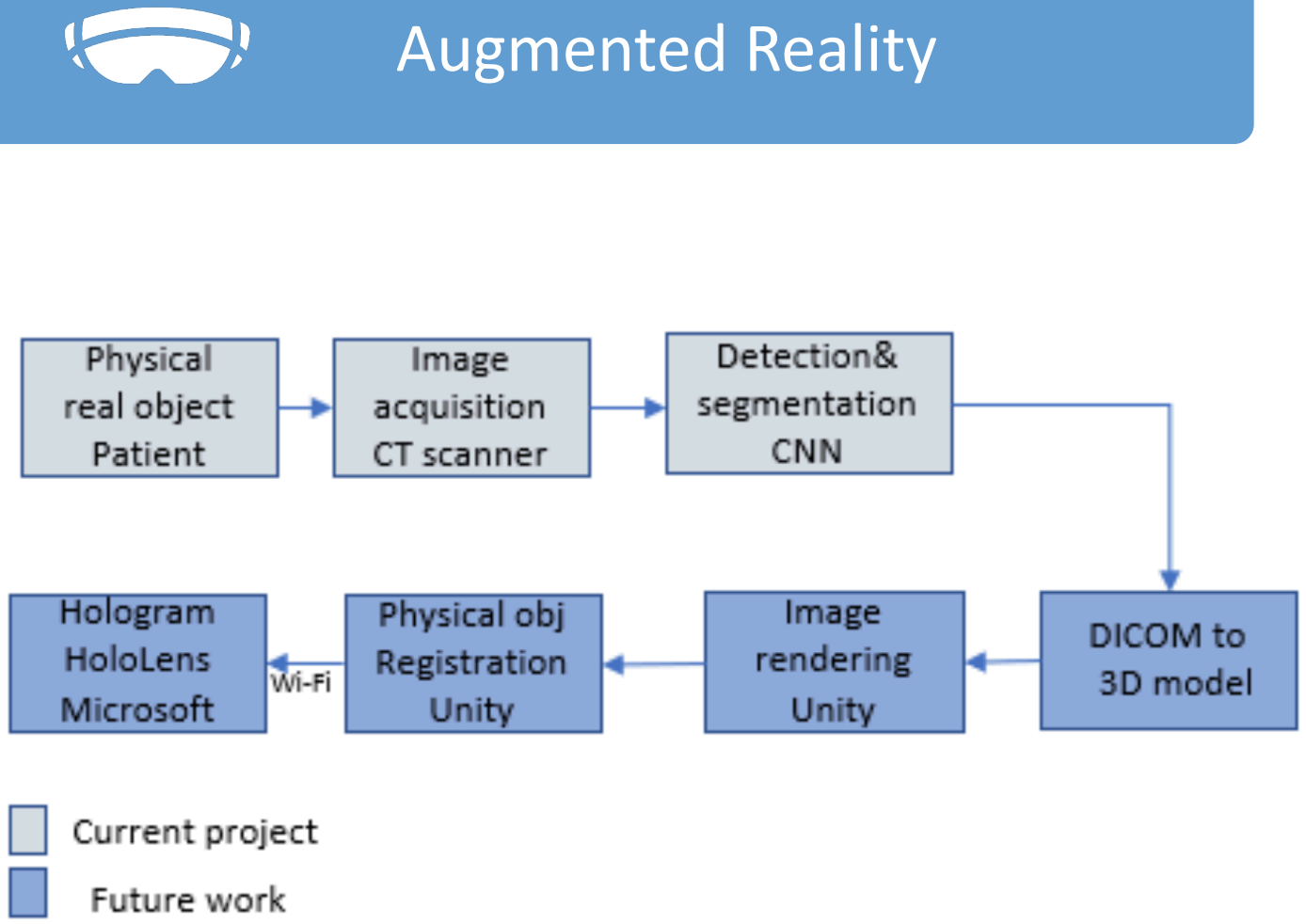
- Model saved and exported
- Web-Application using Python Flask and UI with Bootstrap
- Doctor inputs MRI scan
- File sent into application





FUTURE STEPS

Augmented Reality



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