

SMART INDIA HACKATHON



DEPT. OF ATOMIC ENERGY

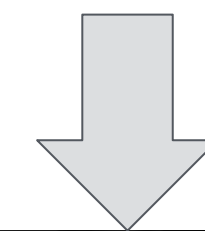
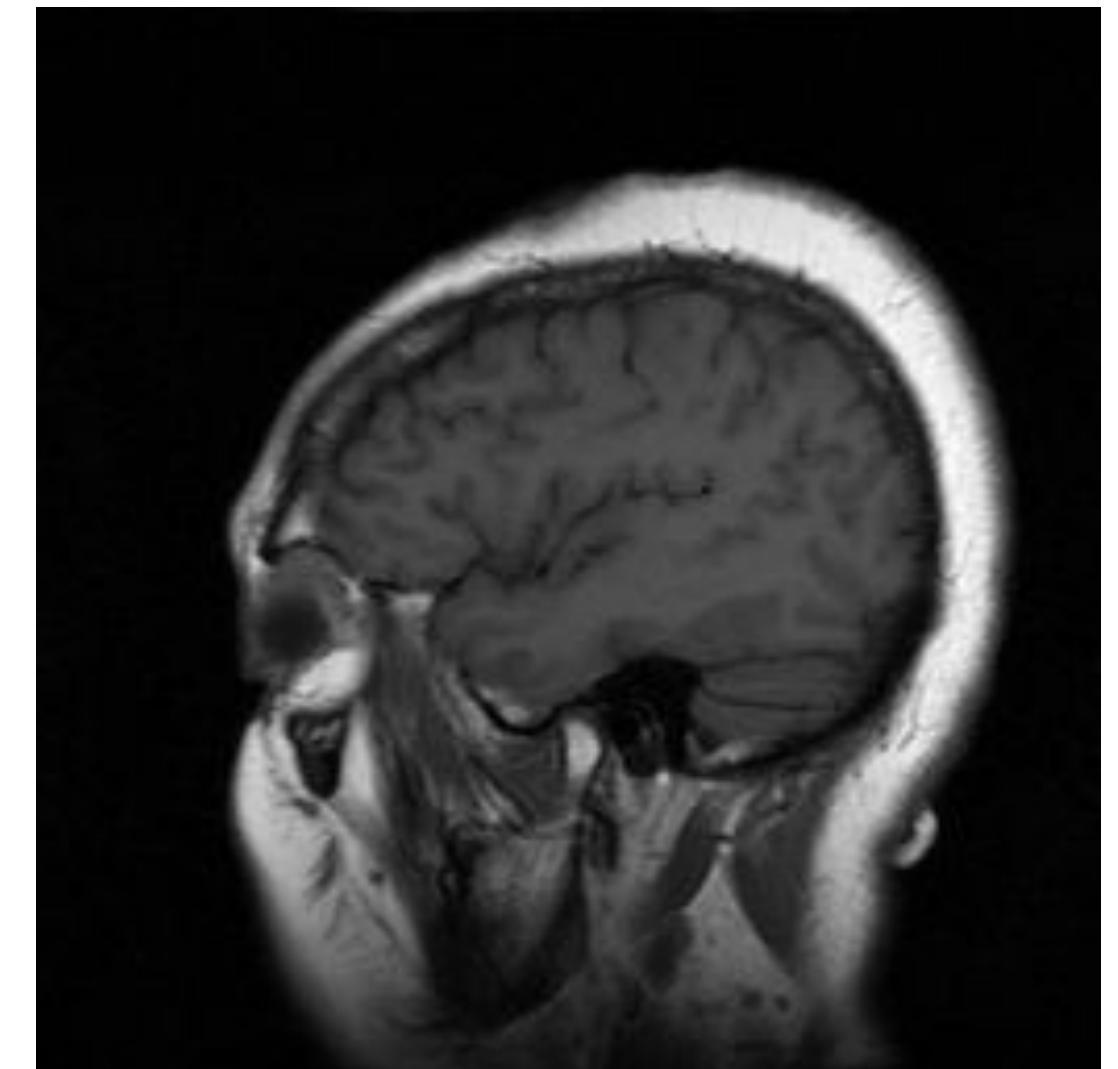
**FIDUCIAL LOCALIZATION
FOR PRE-OPERATIVE
PLANNING IN NEUROSURGERY**

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COLLEGE CODE:U-0804**

PART A: Fiducial Localization and Detection

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- Preparation of a large dataset of MRI fiducials using:
 - Augmentation using scikit
 - Annotation using labelling Tool
- Feature extraction of fiducials.
- Through the concept of transfer learning, we will use the pre-trained model and weights of YOLOv3 model pretrained on COCO dataset, to train on our own datasets.
- Load the model to tweak on the validation dataset.
- Reducing loss using Empirical risk minimization and Hyperparameters tuning.
- Confirm results on test dataset(using mAP value, accuracy, precision, recall and AUC curve).



PART B:
COMPOSING THE TRANSFORMATION
MATRIX(M):

$$\begin{bmatrix} P_x \\ P_y \\ P_z \\ 1 \end{bmatrix} = \begin{bmatrix} X_x \Delta i & Y_x \Delta j & 0 & S_x \\ X_y \Delta i & Y_y \Delta j & 0 & S_y \\ X_z \Delta i & Y_z \Delta j & 0 & S_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} i \\ j \\ 0 \\ 1 \end{bmatrix} = \mathbf{M} \begin{bmatrix} i \\ j \\ 0 \\ 1 \end{bmatrix}$$

1. **Pxyz: the coordinates of the desired voxel in 3D space.**
2. Sxyz: the coordinates of image position patient.
3. Xxyz: the value of direction cosines of row vector.
4. Yxyz: the value of direction cosines of column vector.
5. **(i,j): the value of center of fiducials obtained from part A.**
6. del(i), del(j): pixel spacing in units of mm, along row and column respectively.

Technology Stack:

Programming Language: Python 3

Main Libraries used:

1. Tensorflow-GPU(v1.13.1)
2. Numpy
3. Pillow
4. Scipy
5. Keras 2.x
6. ImageAI(v2.1.5)

Some others include:

7. h5py, random, skimage, os, json, operator, dicom, matplotlib, lxml, mritopng

Tool used for Image annotation:

8. LabelIMG(Pascal VOC format)



Use Case:

- Our model is restricted to be used by Neuronavigation people for medical purposes, for accurate localization of a target, which is then used by a neurosurgeon for Image guided Neurosurgery, which is commonly called as a **point based image registration**.

Dependencies:

- Since we were required to develop an autonomous algorithm so we have restricted ourself to use open source methods and technologies, which involves the use of Python3, and some previously developed libraries such as ImageAI for object detection.
- Secondly, since we are working on dataset involving MRI's which is highly secured therefore we used B.A.R.C's own dataset of MRI images marked with fiducials for the same purpose.