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# **SOFTWARE REQUIREMENTS SPECIFICATIONS**

## **MANUAL DATA ANNOTATOR AND MASK GENERATOR**

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# 1 INTRODUCTION

## 1.1 PURPOSE:

The purpose of this application is to generate a segmentation mask for a given image. The end user drags the mouse pointer and forms a closed loop on the given image. All the pixels in the given loop (along with the boundary) will act as the mask for the given image.

Our application can be used in various fields with some modifications to help solve various problems in the real world. Some of them are as follows:

1.**Brain Tumor Segmentation:**The region of interest for this problem is the area affected by the tumor in the brain. Once this area is identified and segmented, various further studies can be performed. This greatly alleviates the burden on radiologists.

Find the citation [here](#)

2.**Cell Nuclei Segmentation:**This application belongs to the field of microscopy and can be used for lab-related applications. The goal is to segment out the region containing nuclei of various types of cells. This can assist in disease detection, cell counting, and various other medical use cases.

Find the citation [here](#)

3.**Skin Lesion:**This is an application for dermatology where the goal is to segment the area of skin that contains a lesion.

Find the citation [here](#)

4.**Agriculture** : Semantic segmentation methods have revolutionized the development of agricultural automation and are commonly used for crop cover and type analysis, pest and disease identification, etc.

Find the citation [here](#)

5.**Drugs detection:** Depending on the size, color and shape of the drug in the image , the machine can recognize the label of the drug.

Find the citation [here](#)

It can be further modified,developed and can be used for many other purposes with added features.

## 1.2 DOCUMENT CONVENTIONS:

DOCUMENT CONVENTIONS	
.py	Python file
.css	Cascading Style Sheets
.html	HyperText Markup Language
.js	JavaScript
.pt	weights file
.txt	Text file
.png	Portable Network Graphics
.jpg	Joint Photographic Experts Group
.mp4	Moving Picture Experts Group

## 1.3 INTENDED AUDIENCE AND READING SUGGESTIONS:

This project is not just limited to a particular set of audience, it can be used by anyone who wants to annotate images and separate selected parts of the image from the rest.

## 1.4 PROJECT SCOPE/FUNCTIONALITY:

- **Authentication:** Our website has login system with OTP verification process when a user registers.
- **Manual Mask Generator:** It generates a white mask for all the objects around which a loop is drawn manually by the user.
- **All Masks:** This feature generates a white mask around all the objects in the image uploaded by the user.
- **Segmentation For All the Objects:** This feature generates a segmentation mask along with a label and accuracy score for all the detected objects in the image.
- **Selected Segmentation:** This feature generates segmentation mask, label and accuracy score for all the objects inside a bounding box drawn by the user.
- **Segmentation For Video:** This feature generates segmentation mask for all the objects in the video dynamically.
- **Background Removal:** This feature identifies the highest objects whose accuracy score is greater than 0.9 and removes its background.

- **Background Change:** This feature changes the background of an image by another image uploaded by user.
- **User History:** User can access already uploaded images in his account. Uploading and retrieving of images is done using base64.

- **Why Base64 ? :**

1.Ease of use: Base64 encoding can be a simpler approach for small binary data, as it can be stored directly in a field in a regular MongoDB document. This can be convenient for certain use cases where the overhead of using GridFS is not necessary.

2.Speed: Retrieving Base64-encoded data can be faster than retrieving data stored in GridFS, as it requires fewer operations and data transfers. This can be important in scenarios where speed is a critical factor.

3.Portability: Base64-encoded data is essentially just text, which means it can be easily transferred between different systems and applications. This can be useful in scenarios where the data needs to be moved or shared between different platforms.

However, Base64 encoding has some disadvantages as well, such as the increased storage requirements and the fact that it's not suitable for large binary data.

## 1.5 ACKNOWLEDGEMENTS

[YOLOv8 Docs](#)

[Image background removal tutorial](#)

## 2 GLOSSARY

- **Mask:** A mask is a binary image that is used to separate an image into 2 or more regions. A mask is typically used to identify the region of an image that contains the object of interest.
- **Data Annotator:** It is a process of labeling individual elements of training data (whether text, images, audio or video) to help machines understand what exactly is in it and what is important.
- **Image Segmentation :** Image segmentation is the process of partitioning a digital image into multiple image segments, also known as image regions or image objects (sets of pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

## 3 OVERALL DESCRIPTION

### 3.1 PRODUCT PERSPECTIVE

Firstly, the user registers into the website using OTP verification through which a profile gets created in the database in which we can store the history of the user. The application allows user to generate masks manually, generate white masks around all objects, segment images and videos, selective segmentation, remove background and even change the background.

### 3.2 PRODUCT FEATURES

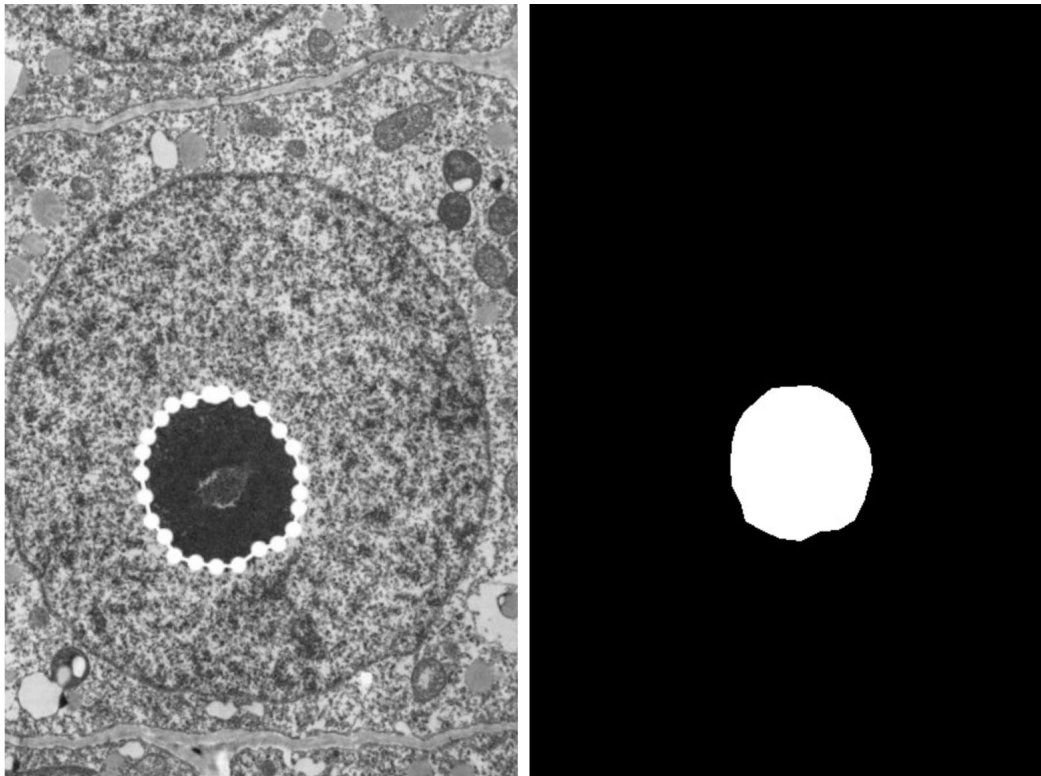


Figure 1: **Manual mask segmentation using polylines**

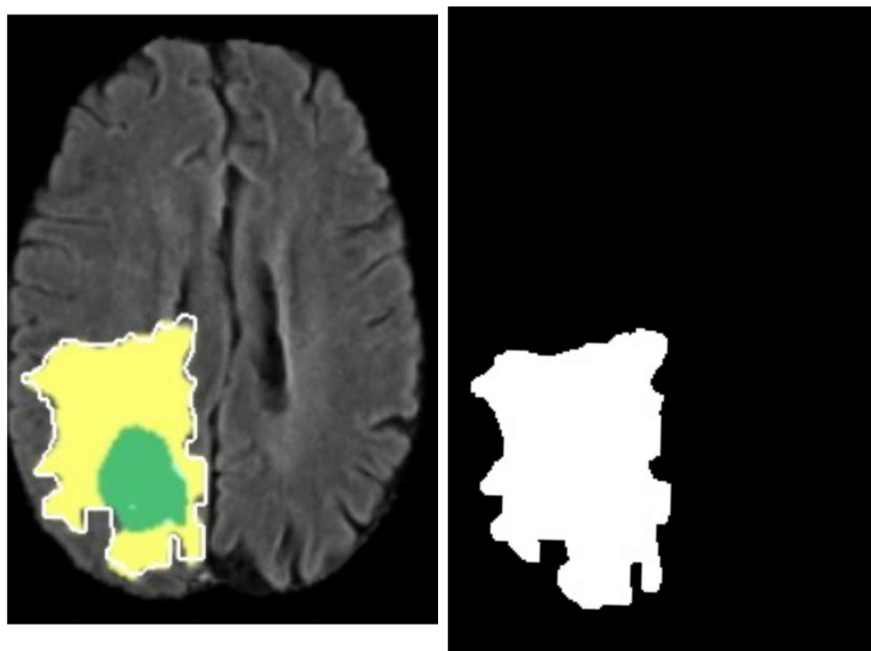


Figure 2: **Manual mask segmentation using free hand**



Figure 3: **Mask segmentation for all objects**





Figure 4: **Instance segmentation for all objects**



Figure 5: **Background change**

### **3.3 OPERATING ENVIRONMENT**

The software will be able to operate on Mac, Windows and Linux.

### **3.4 DESIGN AND IMPLEMENTATION**

Manual mask generation is implemented using OpenCV(a python library).

Object Segmentation is implemented using YOLOv8(a machine learning model that can be used for object detection, image classification, and instance segmentation tasks).

Background Removal and Change is implemented using mediapipe which is a Framework for building machine learning pipelines for processing time-series data like video, audio, etc.

The user interface of our website is intuitive, responsive and user friendly.

## 4 SYSTEM FEATURES

### 4.1 FUNCTIONAL REQUIREMENTS:

#### DEVELOPERS REQUIREMENTS:

- **Proficiency in programming languages:** Developers must be proficient in programming languages such as Python for developing the YOLOv8 model, HTML, CSS and JavaScript for developing user interfaces. They must also be familiar with Flask to be able to connect the ML model with the website.
- **Proficiency in Web Development:** Developers must be proficient in Flask and MongoDB to be able to create a user interface and deploy our website.
- **Proficiency in frameworks** such as OpenCV, Mediapipe
- **Familiarity with Machine learning models:** Developers should have good knowledge of some machine learning models to build our application.
- **Knowledge in Data Visualization tools** such as matplotlib, numpy, PIL.

#### USERS REQUIREMENTS:

- For the uploaded picture, user must be able to draw loops manually around the objects. The application must generate white masks around these loops.
- For the uploaded picture, it should create a mask for the chosen object, and the application should show the user a label for the chosen object.
- In addition to the information about the chosen objects, the application should give the user access to a feature that allows him to, if necessary, obtain labels for every important object in the picture.
- Along with its label, it should also show how accurately the item has been identified as a score.
- The application should have a user friendly interface which should help the user to easily use and navigate through the application.

### 4.2 NON FUNCTIONAL REQUIREMENTS:

- **Security:** Securing the application and its data against unauthorized access, hacking, or other threats. Our website ensures privacy and confidentiality of user's information.
- **Performance:** It deals with the response time , number of users that are simultane-

ously using the application and the amount of data being processed.

- **Reliability:** It should be able to overcome system failures and errors.
- **Scalability:** The ability of the application to control the increasing amount of the data or traffic , as the system grows in size.
- **Accuracy:** The application should be able to detect the selected object to the maximum correctness.
- **Compatibility:** Ability to work with different softwares and hardware platforms , including web browsers , operating systems like linux and windows.
- **User-friendly:** All users should be able to easily use and navigate through the application and be able to find the functionalities they are looking for.