UAS-DTU

Unmanned Aerial Systems - Delhi Technological University

ROUND 2: Technical Round
Software Department

Background

Autonomous image segmentation and feature detection and classification is an important aspect of image processing. Image segmentation is the process of “partitioning a digital image into multiple segments". The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Feature detection includes finding areas of interests such as edges, corners and simple shapes. These features are then classified into various categories based on their shape, colour or other inherent features. These concepts are widely used in military and civilian UAV missions to gather information about areas out of human reach, such as disaster-stricken or mountainous areas.

Task

The theme for this task is Search and Rescue. A shipwreck has occurred in the ocean, and your job is to gather information about the location and condition of stranded passengers. Your UAV is collecting aerial images of the wreckage that look like the sample image given below.

Information about the input image :

- The input image is divided into two primary regions: the blue region corresponds to ocean, while the brown/green region corresponds to land. Passengers within the image are denoted by geometric shapes, with stars representing children, squares representing adults, and triangles representing elderly individuals.
- The severity of each civilian’s condition is represented through color coding: red indicates severe condition, yellow indicates mild condition, and green indicates safe.
- Additionally, the image contains three designated rescue pads (zones for evacuation and safety denoted by circle). Among these, two rescue pads are situated on land and one rescue pad is located in water. While all rescue pads serve the same purpose, civilians are required to be assigned to the best available rescue pad based on their position in the image and their medical emergency while keeping in check the capacity.

Sample Image

The task for you is to devise a method to assign each of the casualty to the best possible rescue camp while making sure that the final casualty configuration for each of the camp is their respective best possible combination based on the casualty scores. . This must be based on the following rules :

Priority order of casualties : Star-3(Highest), Triangle-2, Square-1(Lowest)
Priority order of emergency : Severe-3(Highest), Mild-2, Safe-1(Lowest)
Max capacity of rescue camps : Pink-3 casualties, Blue-4 casualties, Grey-2 casualties

The best rescue camp for a particular casualty is based on a final score calculated by the amalgamation of the Priority score and distance where the priority score is Priority(casualty*emergency). In case of a similar priority score , a casualty with higher emergency score will be given importance. Devise your own score taking in all the considerations and keep in mind the max capacity of the camps while making sure that each camp has the highest possible total priority score.

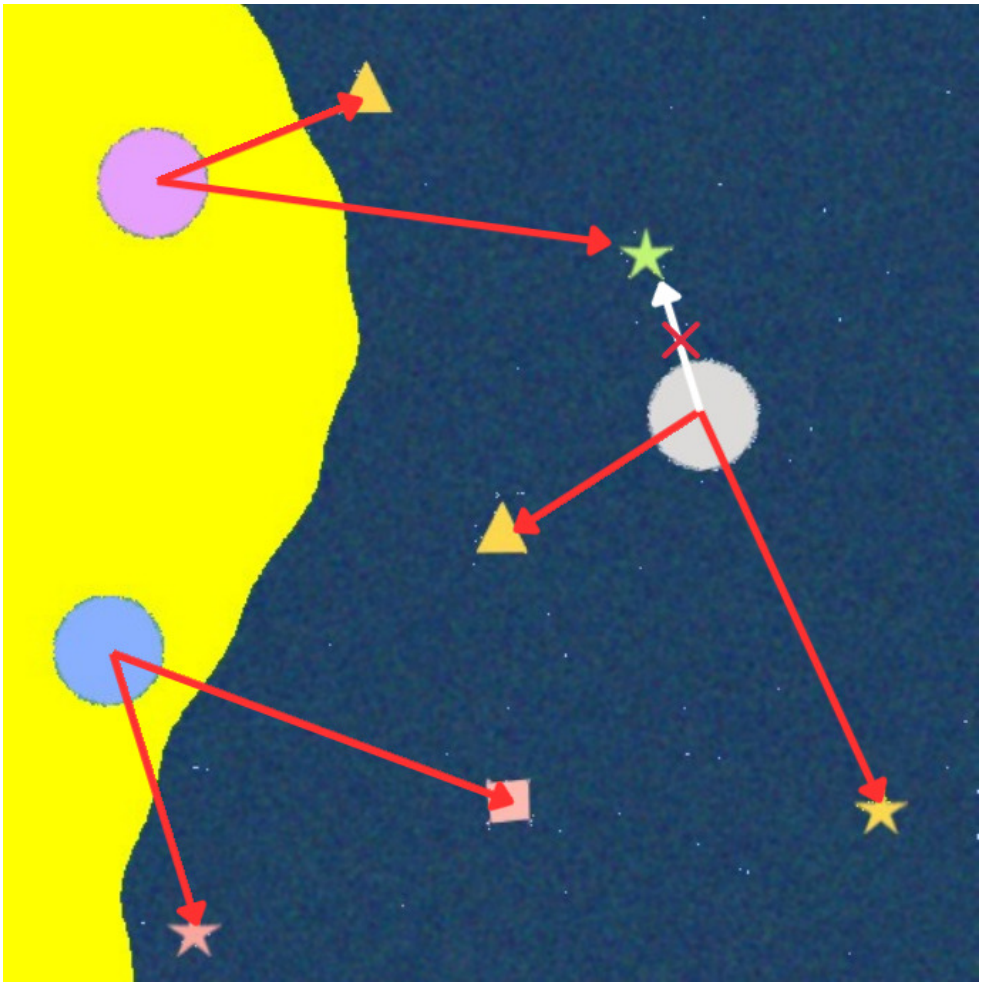
Input

A list of 10 images, similar to the sample image provided above

Expected Output

1. An output image, for each input image, that clearly shows the difference between the ocean and land, by overlaying 2 unique colors on top of each. The expected output for the given sample input is given below.
2. a)Count the number of casualties assigned to each of the three camps.
   b)The details of casualties assigned to each of the three camps for each image (Age-group ,medical emergency) in the order **[blue,pink,grey].**
3. The total priority of each of the camps saved in a list and the avg. priority of the image (rescue ratio of priority P_r) , calculated by summing the priorities of the camps and averaging over the number of casualties.
4. A list of the names of the input images , arranges in descending order of their rescue ratio (P_r)

The expected output for the given sample image is given below



Sample output (Arrows are used for explanation)

1. [[**[3,3],[1,2]**] , [**[2,2],[3,1]**] , [**[3,2],[2,2]**]] green star was assigned to pink camp due to lower priority than yellow triangle although distance must also be considered which will be based on your score formula.
2. [[2,2]] (Priority score of casualty = 2x2 = 4 (for safe elderly) and along with distance calculate your own defined score.
3. [[Summation of scores for blue] ,[Summation of scores for pink] ,[Summation of scores for grey]]
4. [image1, image3, image4….. etc] (this is based on the priority ratio of the various images given as input) **(not related to the given sample image)**

Example:

Input images:

Image1

Image2

Sample Output:

Segmented Images for ocean and land.

Image_n= [[**[1,1],[1,2],[1,3],[3,2]**] , [**[3,1],[2,3],[3,3]**] , [**[2,1],[2,2]**]] for max 9 casualties.

Camp_priority = [[24,45,56],[25,50,70]]

Priority_ratio = [125/8=15.625,145/9=16.1]

image_by_rescue _ratio = [Image2, Image1]

To simplify the given task, we've given a step by step approach to learn various concepts and libraries that are required to complete the task

Step By Step

1. [Optional] Install Ubuntu in your disk partition, refer to this link (https://www.youtube.com/watch?v=GXxTxBPKecQ) for details on how to do this. Note that this task often takes time but we highly encourage you to use Ubuntu once recruited so doing this might give a head start. But note that this is purely optional and you will not be evaluated on the basis of this.
2. Learning and picking up new things is the key to work we do. Download and learn Python3, get comfortable with basic data structures used in Python3 (lists, dict, strings, etc). If you know CPP this might not be a steep learning curve. Refer to the beautifully written documentation python has to offer. https://docs.python.org/3.10/ Also, refer to youtube and blogs for learning quickly.
3. Learn the basics of NumPy. It is the fundamental package for scientific computing with Python. NumPy brings the computational power of languages like C and Fortran to Python, a language much easier to learn and use. With this power comes simplicity and speed. You can refer to these tutorials:

https://www.codecademy.com/learn/intro-statistics-numpy/modules/dspath-intro_-numpy. If you want to go deeper you can read the official documentation of NumPy on https://numpy.org/ or YouTube videos.

4. Learn the basics of OpenCV (Open Source Computer Vision Library), It is an open-source computer vision and machine learning software library which is available in multiple programming languages. You can refer to this video lecture series to learn the basics quickly: https://pythonprogramming.net/loading-images-python-opencv-tutorial/. You can also refer to the official documentation of OpenCV on https://opencv.org/ or YouTube videos.
5. Maintain a logbook or write a short report of details showing on a google doc. Share this with your mentor on his/her email address.
    a. What did you do each day?
    b. What changes did you make to your code to improve its performance?
        i. Error Analysis
        ii. Identify areas of improvement
        iii. Make changes
        iv. Write it down

The task should be compulsorily done on GitHub and should have a comprehensive readme.

Evaluation Criteria:

1. Your overall approach to understanding the basics of python
2. Understanding of basic NumPy and OpenCV
3. Code writing skills (is the code clean, well commented)
4. Skills in understanding and usage of new tools which are integral to the work that we are doing here.
5. Documentation.
6. Ability to think analytically and critically.
7. Ability to do the error analysis appropriately.
8. Most importantly grit and commitment!

Task Deadline : 1st September 2025 (12:00 PM)

Relevant Links:

- Dual boot Ubuntu 22.04 and Windows 11: https://www.youtube.com/watch?v=GXxTxBPKecQ
- Python 3.10: https://docs.python.org/3.10/
- Learn Python 3: https://automatetheboringstuff.com/ (First 6 chapters are sufficient)
- Learn OpenCV: https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html [Video Lecture]
- Learn GitHub : https://docs.github.com/en/get-started/quickstart/hello-world

End Note:

For those of you with a background in programming and knowledge of python we assume this task won't be very difficult for you. Similarly if someone's just starting off with python this may seem overwhelming and impossible. We need you to know **that's okay and your previous knowledge will not play a role in our selection.** We will make sure it's a level playing field for everyone, so in case you're just starting out we don't expect you to complete this task 100% but we expect 100% follow through and dedication from all. If you are able to complete this task earlier than stipulated time we will assign more things to you, the purpose of this task is to see your adaptability to new environments so we encourage you to ask doubts search the internet and find solutions and most importantly enjoy (you will most likely have a good looking project by the end of this recruitment)

We wish you all the best, and hope to work with you soon!

Mentor Division

Please find your specific mentor and ask questions only to that mentor, it really helps our management if you stick to the person assigned. Please refrain from calling unnecessarily. Drop a text message or an email.

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