# Aerial Robotics Kharagpur Documentation Task 1

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***Abstract*— I have taken up the problem of finding the numbers of pi from the given image and comparing it with an actual pi whose digits were converted to an image by using numpy array. I have also applied a filter onto a given image and obtained back a famous portrait and checked the leigbility of the said artwork. Later on I also decoded the password to a protected zip file by template matching with a collage**

**Template matching is commonly used for detecting instances of an object within an image. A template, which is a small image or pattern representing the object of interest, is compared with different regions of the image to find matches. When a match is found, it indicates the presence and location of the object in the image. It is also used for image restoration. Filter convolution is used here to remove noise or artifacts from degraded images. By convolving the image with specific filters designed for denoising or restoration, unwanted elements can be attenuated, and the original image quality can be restored.**

## I. INTRODUCTION

Describe the problem statement and your approach using which you have approached the problem. Describe all the things and methods you have tried which might have failed in brief.

## II. PROBLEM STATEMENT

We were given a corrupted image that contained the digits of pi encoded in it. And we were to find the correct digits in place of the corrupted pixels. And after that take those corrupted pixels to form a 2*2 filter. Later we were called for the investigation of the legibility of an artwork. The artwork was suspected to be a distorted image of a famous personality. So we did it by getting some intel about the artist of the artwork who knew only three mathematical operations. Then once the famous portrait was retrieved, we were to do template matching on a collage and find the password of a locked zip file.

## III. RELATED WORK

First I took the first 2500 digits of pi and put it in a file separately. Then I read this file from the main code and appended the individual digits of this file into a list. Jain, I also loaded the corrupted image of pi given and put the digits of this matrix in the list. Then I compare these two lists, and so I got the digits of pi that were corrupted which were 3, 0, 8, 7. From this, I got the two by two filter which was 0, 94, 219, 251. Then I applied the XOR function onto the artwork and found the famous portrait image. Then I implemented my own template, matching function and found the coordinates of the template, namely the top left coordinates. With these coordinates, I was able to find the password to the locked file '628'.

Fig. 1. The fampus portrait that was retrieved

## IV. INITIAL ATTEMPTS

My initial attempt was to compare the digits of pi and I was able to do this by importing the 2500 digits of pi into a separate file and appending it to a list number by number and comparing it with the corrupted by image, which was also converted to a list. Next I used the filter obtained to traverse over the artwork in which I ran into a problem. I had not used the correct data types of the resultant matrix into which I was changing the pixel values to retrieve the famous portrait. I realised that mistake, and so I changed the original famous artwork into the resultant. I wrote three different functions to do this with the three different operations XOR, AND and OR and found the function with XOR operation to give back the famous portrait. Then I implemented my own template matching function to find the coordinates of the template in the image. What the template matching function does is that it places the template on top of the image and subtract the corresponding values then it squares each of these values and adds them and stores it at the index of the top left corner of the image on which this template is already on top of. Now in this resultant matrix the index with the least number will be there coordinate of the template since most pixels would have matched.

## V. FINAL APPROACH

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I was able to find the actual portrait and the image is shown.

## VI. FUTURE WORK

The template matching function, which I have implemented is not guaranteed to do complete matching every time because of the underlying mathematics formulation used, which just looks for the least value in the resultant and matrix. This algorithm can be improved and a more robust algorithm can be put in place which guarantees template matching to a greater precision.

## CONCLUSION

This problem really helped me in understanding the concepts of computer vision and template matching and I also got familiarised to use the numpy library of Python.