MAE 527: INTELLIGENT CAD INTERFACES

FINAL PROJECT

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-BY-

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The Method of Implementation:

Two methods were implemented in this project. The first method used was Image Based Classifier and the Second method implemented was $1 Recognizer.

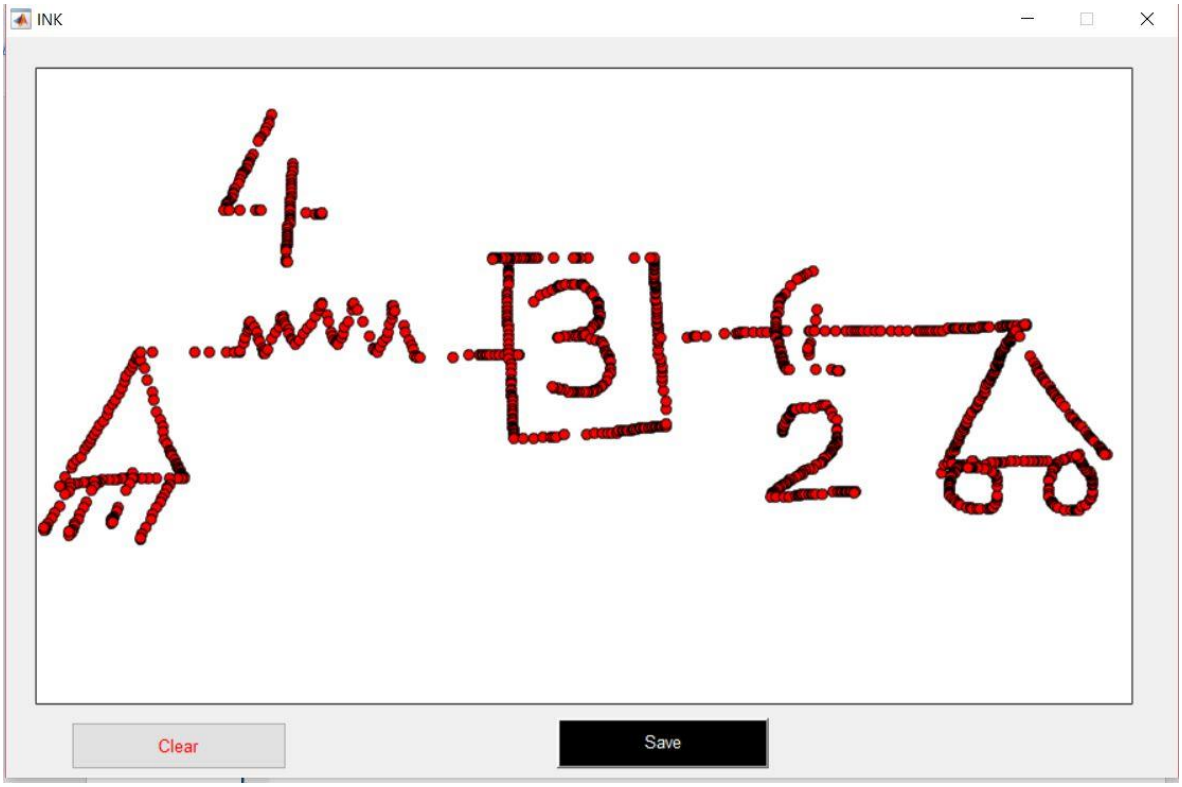
The Name and Number of Classes:

For this project, the basic aim was to draw a mass body diagram consisting of a block, supports- either roller or fixed, spring, dampers and numbers to weigh them. Thus the total number of classes used to train the algorithm were 15. Following are the details of these classes with their representation

SR.NO.	CLASS NAME	IMAGE OF CLASS	# OF STROKES TO DRAW THE CLASS
1.	Fixed Support		5(Triangle-1, Lines-4)
2.	Block		1
3.	Roller Support		3(Triangle-1, Circles-2)
4.	Spring		1
5.	Damper		4
6.	0		1
7.	1		2

SR.NO.	CLASS NAME	IMAGE OF CLASS	# OF STROKES TO DRAW THE CLASS
8.	2		1
9.	3		1
10.	4		2
11.	5		1
12.	6		1
13.	7		1
14.	8		1
15.	9		1

Sample Mass Diagram Input and Output shown in the following figure



Input Mass Diagram

```
Command Window
>> INK
    OUTPUT FOR IMAGE BASED CLASSIFIER
    The 1th sketch you drawn in mass diagram is a Roller-Support
    The 2th sketch you drawn in mass diagram is a Spring
    The 3th sketch you drawn in mass diagram is a Block
    The 4th sketch you drawn in mass diagram is a Damper
    The 5th sketch you drawn in mass diagram is Fixed-Support
    The 6th sketch you drawn in mass diagram is a 4
    The 7th sketch you drawn in mass diagram is a 3
    The 8th sketch you drawn in mass diagram is a 2
    Your number 4 is above the object
    Your number 3 is inside the object
    Your number 2 is below the object
    Your 3 number is to the right of 4 number
    Your 2 number is to the right of 3 number
    Your Spring object is to the right of Roller-Support object
    Your Block object is to the right of Spring object
    Your Damper object is to the right of Block object
    Your Fixed-Support object is to the right of Damper object
```

Image Based Classifier Output

```
OUTPUT FOR $1 CLASSIFIER
The 1th sketch you drawn in mass diagram is a Roller-Support
The 2th sketch you drawn in mass diagram is a Spring
The 3th sketch you drawn in mass diagram is a Block
The 4th sketch you drawn in mass diagram is a Damper
The 5th sketch you drawn in mass diagram is Fixed-Support
The 6th sketch you drawn in mass diagram is a 4
The 7th sketch you drawn in mass diagram is a 3
The 8th sketch you drawn in mass diagram is a 2
Your number 4 is above the object
Your number 3 is inside the object
Your number 2 is below the object
Your 3 number is to the right of 4 number
Your 2 number is to the right of 3 number
Your Spring object is to the right of Roller-Support object
Your Block object is to the right of Spring object
Your Damper object is to the right of Block object
Your Fixed-Support object is to the right of Damper object>>
```

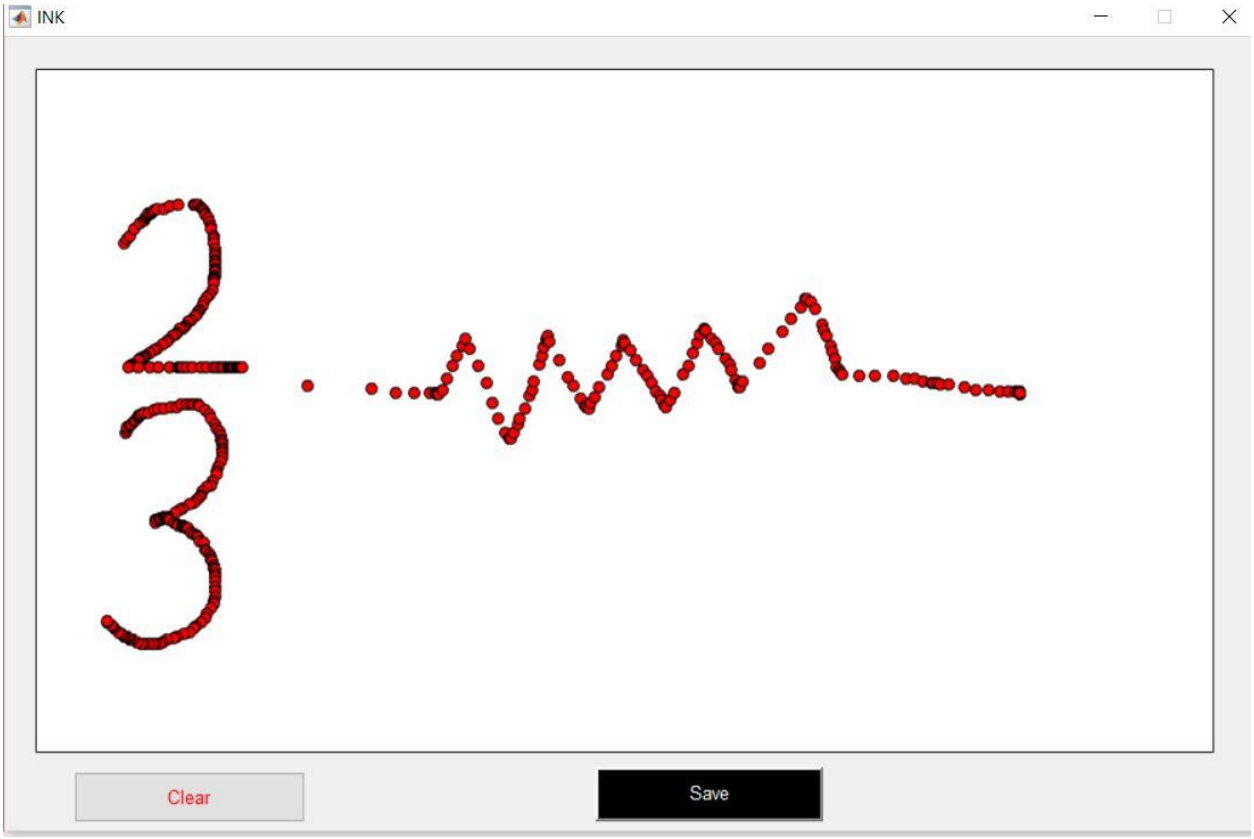
$1 Recognizer Output

Note:

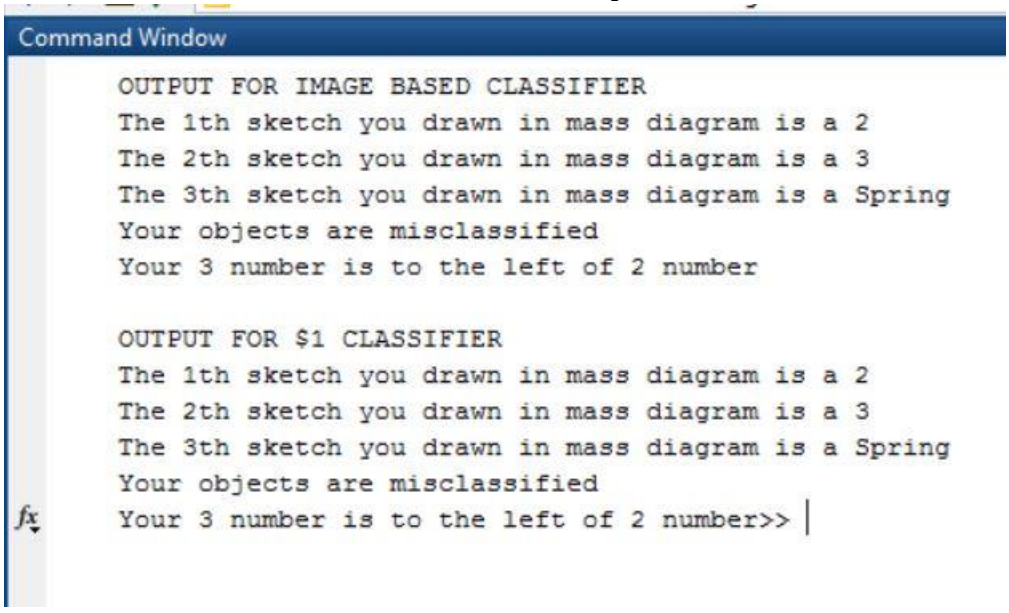
The classifier will work only if at least one of both objects and numbers is drawn in the GUI. The code is written in such a way that it will work only when both numbers and objects are drawn else it will give an error of undefined variables.

The output of the classifiers will provide following information:

1. The object or number you draw and in the order you draw. For example, in above output figures, we drew the Fixed-support first, then we drew spring and successively we drew Block, Damper, Roller-Support, 4,3,2.
2. It will provide the location of each number if it is above the object or inside the object or below the object. In the example images provided, 4 is draw above the object, 3 is inside the block and 2 is below the damper. Thus the output can provide this information.
3. Similarly, it will also provide the location of the objects in the order you draw them as can be seen in the outputs above.
4. If we draw two numbers one above the other, it will misclassify as can be seen in the below images.



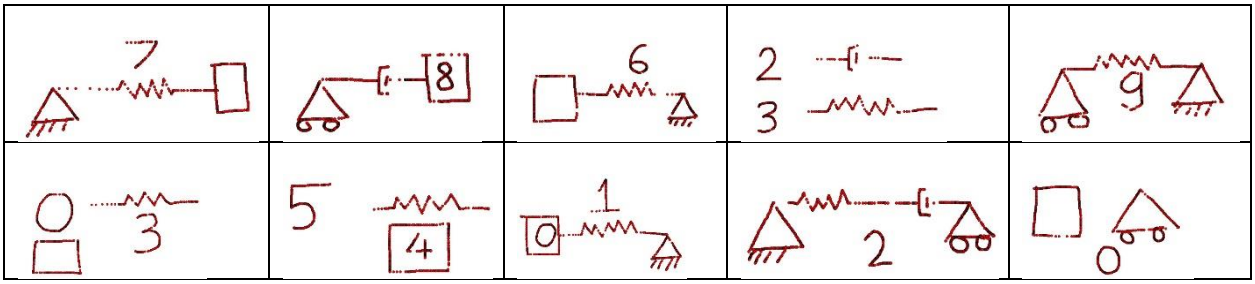
Misclassification Input



Misclassification Output

Error Analysis:

For error analysis, we drew 10 different diagrams with two unbiased users. Only instructions given were they need to keep at least 1 second gap while drawing two separate objects or numbers. Furthermore, they were also informed how many stokes they need to draw for objects. And to draw the strokes naturally so that the threshold to separate the strokes won't exceed 0.5 seconds. The ten figures that were drawn by these users are as follows



1. For the first image, the image based classifier classified 7 as 3 for user 1and B as zero for user 2. The $1 recognizer classified spring as damper for both the users.
2. For the second image, both classifiers gave no error for both users.
3. For the third image, both the image based and $1 recognizer classified the roller support as fixed support for user 1. User 2 had no classification errors.
4. For the fourth image, no error occurred for user 1. For user 2, the $1 recognizer classified 2 as 1. Image based classifier worked fine.
5. For the fifth image, the $1 recognizer classified 9 as 3 for user 1. There was no misclassification in image based classifier for both users. The $1 recognizer worked fine for user 2.
6. For the sixth image, there was no classification error for both users.
7. For the seventh image, the image based classifier classified 4 as a fixed support for user 2. $1 recognizer worked fine. User 1 had no errors.
8. For the eighth test, the $1 recognizer misclassified Fixed support as roller support for user 1. While the $1 recognizer for user 2 classified 1 as 2. Image based classifier worked fine for both users.
9. For the ninth test, there was no error for user 1. For user 2, the $1 recognizer classified roller support as fixed support.
10. For the final test, there was no error for user 2. For user 1 image based classifier did not misclassify however, the $1 recognizer classified 0 as 6.

Thus, for user 1 the image based classifier misclassified twice giving 2 errors total while the $1 Recognizer had 5 errors.
For user 2, the image based classifier had 2 errors while the $1 Recognizer had 4 errors.
Thus we can conclude that the Image Based Classifier worked better than the $1 recognizer for this project.