



Cardiff School of Computer Science & Informatics

CM3203

One Semester Individual Project

40 Credits

Initial Plan

Handwriting Recognition Using Image Processing

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Project Description

The main idea of this project is to be able to off line, recognise handwritten characters from an input image and output the results into a text file. Using MATLAB, I will construct a recognition application that will be able to read an image and be able to identify the characters present in the image.

The first step of creating my recognition application is the preparation of processing the image. For example, an image could have variations in lighting or distortion of noise. The application needs to reduce these unwanted features in order to recognise the handwritten characters by using techniques such as Median Filter. However, by trying to reducing noise, we would sacrifice some detail, which means the application needs to adopt the suitable techniques that will minimise losing details in the image, whilst removing the necessary noise.

Furthermore, the image will be converted into either grayscale or binary to distinguish what is background and what are the objects (the handwritten characters). A threshold could be implemented along with the conversion, where the application can accept what is background or handwritten characters depending on the given intensity value of the pixel.

Once the pre-processing stage is completed, the application will try to segment each handwritten character. The segmentation will capture the handwritten character by using techniques such as Universe of discourse[1], which defines “the shortest matrix that fits the entire character skeleton”. Multiple techniques will be tested to determine which technique (or combination of techniques) successfully identify each handwritten character.

The application will require feature detection techniques that would uniquely identify characters. For example, using Histogram of Gradient (HoG) which produces a gradient magnitude histograms.

A training set will be provided in order to build the classifier, where the classifier, such as SVM or neural networks, should be able to 100% (or close to it) successfully recognise each handwritten character in the training set. The classifier is rigorously tested with new data to evaluate its effectiveness in classifying the handwritten characters.

Project Aims and Objectives

Aim: Pre-process the input image.

Objectives:

- Implement functionality that converts the input image into grayscale.
- Research noise reduction techniques, such as Median filter to remove noise for better performance in later processing, i.e. noise won't be detected as blobs.
- Implement functionality that reduces the noise, whilst keeping the necessary quality of the handwritten characters.

Aim: Distinguish individual characters.

Objectives:

- Research image segmentation methods, such as blobs to detect individual handwritten characters.
- Implement various segmentation methods.
- Experiment to see which method is more accurate at segmenting the characters.

Aim: Detect descriptors/features to uniquely identify each character.

Objectives:

- Research algorithms that extracts unique features from the characters, such as HoG or SIFT.
- Experiment with different type of features.
- Using a combination of features, evaluate them with the classifier.

Aim: Build a classifier.

Objectives:

- Research classifiers, in particular, SVM and neural networks.
- Implement the most appropriate classifier for the application. For example, using neural networks for machine learning.
- Evaluate the classifier.

Aim: Test System

Objectives:

- Test application for invariants in terms of:
 - i. Translation
 - ii. Size
 - iii. Rotation
- Obtain a suitable correctness with the classification scheme used.

- Such as robust testing to see if the application will detect false negatives.

Aim: Investigate future prospects of the system

Objectives:

- Provide a sound future improvements that the system could adopt in order to improve the system, whether in terms of usability or correctness of the classifier.

Aim: Investigate current technologies

Objectives:

- Research past and current projects within the similar field as the project.
- Compare and contrast these projects.
- Collect and conclude findings.

Aim: Investigate useful libraries in MATLAB

Objectives:

- Research libraries that may serve useful to solving the project.
- Experiment with the libraries.
- Evaluate which would be useful and applicable for the project.

Ethics

After discussions with my supervisor and checking the university's research ethics, my project will not require ethical approval. Should the project changes, an appropriate approval and documentation will be created.

Work Plan

Continuous Tasks

During the process of my project, I will have weekly meetings (Tuesdays at 11am) with my supervisor. The purpose of these meetings is to discuss the progress of the project, such as making sure I keep on track of my scheduled plan. There may be occasions where we do not meet, i.e. slow progress with the project, so there is not much to discuss.

In regards to the final report, I will continuously keep notes which describes any changes to my approach or general progress of my project. These would be useful when it comes to writing the final report.

Deliverables

- Application which performs image processing, capable of recognising handwritten characters.
- Final report containing:
 - Documentation that discuss my approach of the problem.
 - Evaluation of the application with reference to the aims and objectives.
 - Such as which aims and objects had been successful/unsuccessful.
 - Discussion of the future prospects of the application.
 - Conclusion relating to my personal development of the project.

Weekly Plan

Week 1: 25th - 31st January

- Complete and submit the initial plan.
 - Investigate the current technologies/approaches used relevant my project.
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Week 2: 1st - 7th February

- Conclude my findings of the current technologies.
 - Research pre-processing techniques, such as Median Filter, converting image into grayscale/binary, to reduce noise from the image, whilst managing to keep the details of the handwritten characters.
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Week 3: 8th - 14th February

- Continuation of the work mention in Week 2, regarding pre-processing techniques.
 - Implement and experiment with the techniques to figure out which technique(s) provides a suitable format to work with.
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Week 4: 15th - 21st February

- Leniency given to pre-processing stage if needed, i.e. extra time to complete the stage.
 - Research some segmentation methods, such as working with blobs that indicates the location of individual handwritten characters and producing a bounding box around it.
 - Start to implement the segmentation techniques to identify which performs the best.
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Week 5: 22nd - 28th February

- Complete implementation of segmentation technique(s).
- Review meeting with supervisor to discuss progression of the project.

Week 6 - 7: 29th February - 13th March

- Research image feature extraction techniques that would be used to uniquely identify every character.
 - Provide a complete implementation of the feature extraction techniques such as Histogram of Gradient or SIFT.
 - The feature extraction will be used to conduct the classification scheme, which means the classifying stage is dependent on the results of successful extraction.
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Week 8: 14th - 20th March

- Final review meeting with supervisor to discuss the progress of the report and what my plans are during Easter.
 - Research suitable classifier for the application, such as Support Vector Machine and Neural Networks.
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Week 9 – 11: 21st March - 10th April

- Provide a complete implement of the appropriate classifier and if there's additional time, experiment with other classification schemes to see if they produce better results.
 - Test the classifier(s) with test set to give an indication of how effective the classifier is.
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Week 12 – 13: 11th - 24th April

- Evaluate the performance of the final classification scheme in the application.
 - Identify any difficulties the classifier may have in recognising invariant handwritten characters.
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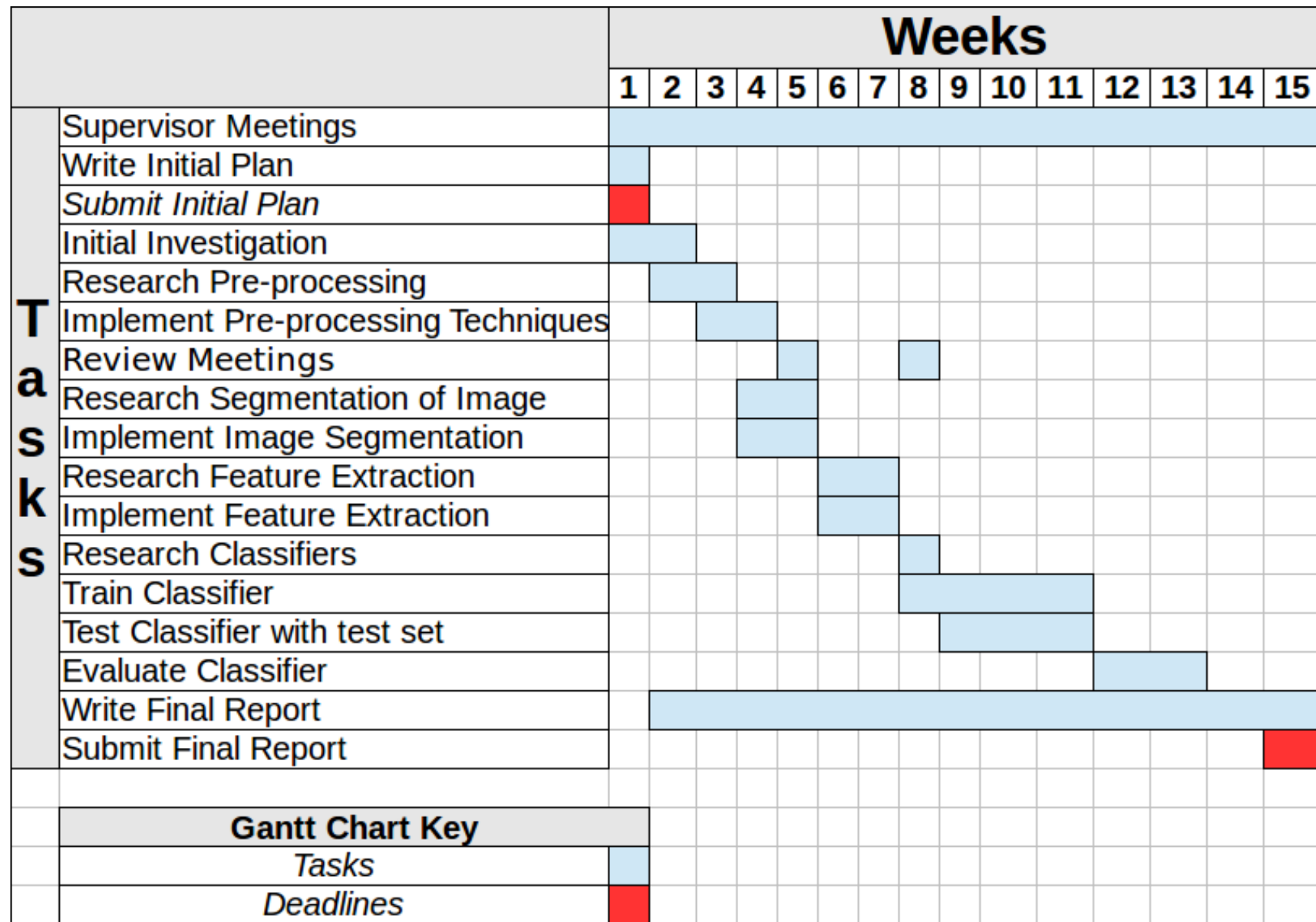
Week 14: 25th April - 1st May

- Create the structure of the final report and start to write up the details of the report.
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Week 15: 2nd May - 6th May

- Complete and submit the final report.

Gantt Chart



Reference

1. Dinesh Dileep Gaurav and Renu Ramesh. 2012. *A feature extraction technique based on character geometry for character recognition [Online]*. Available at: <http://arxiv.org/pdf/1202.3884.pdf>
[Accessed: 28 May 2016]