MapMyNotes

Final Report for CS39440 Major Project

Author: Ryan Gouldsmith (ryg1@aber.ac.uk)

Supervisor: Dr. Hannah Dee (hmd1@aber.ac.uk)

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Department of Computer Science

Aberystwyth University

Aberystwyth

Ceredigion

SY23 3DB

Wales, UK

Declaration of originality

In signing below, I confirm that:

- This submission is my own work, except where clearly indicated.

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Consent to share this work

In signing below, I hereby agree to this dissertation being made available to other students and academic staff of the Aberystwyth Computer Science Department.

Name ....

Date ....

Acknowledgements

I am grateful to...

I'd like to thank...

Abstract

Include an abstract for your project. This should be no more than 300 words.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1

Background & Objectives

1.1 Background

Handwriting notes is still considered to be an important aspect of note taking. In [SMOKER CITE] a study was conducted and out of 61 adults 72.1% prefered to take notes using pen and paper, rather than on a computer. Smoker et al [Cite] concluded that recall rates for handwritten text was greater than that of typed text - prooving handwriting notes are viable.

However technology has advanced and we're moving into an era where we track and view everything digitally, from email to calendar entries. Therefore, there is a need to transfer the productivity from handwritten notes to digital notes - so they can be located easily.

1.1.1 Similar Systems

There are a number of systems which offer similar, and sometimes the same functionality that MapMyNotesApplication would use. The systems are

- OneNote

- EverNote

Each of these tools offer something slightly different and it would be good to produce a system that would encapse these different aspects.

1.1.1.1 OneNote

OneNote is a note-taking and organisational app made by Microsoft [cite].

1.1.1.2 EverNote

EverNote is a note-taking and note organisation app, it is both supported on the web and in app form. EverNote is widely used and would provide a lot of the functionality a user would need to upload their note. They have realeased development articles [CITE-2013 one] stating that they are

able to do OCR recognition on images. This would allow the user to upload an image and it would give a list of words, which it thinks is the word identified. This differs from MapMyNotes where the author aims to develop an application which would give a 1-1 word comparision, rather than a list of words.

1.1.2   Why this project?

The author's motivation for this project is to provide a tool, which initially would be tailored to lecturer based note content. Often notes are written up, but discarded into a big pile and later they're hard to find. As a user, it would be good if the notes were all in one place that they could photograph in and it would automatically create meta-data for it and save it to their calendar. Often the modules that are undertaken are stored in my calendar as a reminder that there's a lecturer on that day - so providing a link to the event in the calendar would be a nice way to tie all these dispersed information together.

1.2   Analysis

By analysing the problem a taxonomy of notes was collated. This helped to breakdown exactly what was in a set of notes. This taxonomy gave a comprehensive analysis of what information would be available to parse from the test, as well as giving the information parsed semantic meaning. It was quickly brought up that I should potentially create a specific layout for the note so that the data can be parsed sensibly, to reduce the complexity.

After identifying that handwriting recognition would be a part of the application then research began investigating what OCR (optical character recognition) tools are available. It was suggested that the open source tool Tesseract [cite] would be an appropriate tool. Instead of using an OCR tool then I could have focussed my dissertation on analysing notes and extracting user's handwriting from it - however, that is not within the aim of the project. As it is more of a tool to use, then using an OCR eases the complexity.

The main objective of the tool would allow a user to upload a photo of their handwritten notes. It will use very basic OCR analysis of meta-data such as the date, lecturer, module code, lecture title and location from the user's handwriting. For the very basic application the handwriting would analyse the author's handwriting. The application will be able to add and edit meta-data relating to a note they upload to the web application. The user will then be able to search for a given module code, they would then be expected to view their notes that they have made. Futhermore, they would be expected to be able to view all the notes that they have entered into the application.

With the web application, it is expected that the user will be able to integrate with their calendar. Google Calendar has been chosen for the calendar the application will interact with. This would have to interact via oAuth. The calendar would be integrated when the user views the homepage to see all their notes, and when they save the note it will update a calendar event of the given day - adding the note URL.

Ideally, there would be more features available in the release but due to the time constraints then certain functionality was not in the primary goals. Analysing the whole note and converting it all to text and displaying the appropriate colour from the note would have been a nice feature to have and would have been really useful. However, this is far too complex within the timeframe

that was available. Instead the parsing of the meta-data would be considered enough instead of this additional feature.

During the first few meetings my supervisor, Dr Hannah Dee, it was discussed what was actually plausable in the time frame. Acknowledging that the project was large and could be expanded we opted to rein in the features and get a minimal project. Dr Hannah Dee suggested that the just the application without the Tesseract parsing would be enough for a minimal product, however I wanted the ability to try and recognise handwriting recognition. So we comprised but mentioned that the handwriting recognition would be a background process, and not the main aim.

- Looked into different ways to binarise an image accordingly.

- Created a list of user stories after the discussion with hannah to decompose the problems.

- I chose to do OCR recognition for singular pages and hopefully getting th etop 3 lines as meta-data than normal notes because I needed structure.

1.3   Process

Due to the flexibility and the unknown nature of certain aspects of the project, such as how long handwriting training and the calendar integration would take, then a normal plan-driven approach like the waterfall approach would not be suitable. Therefore, due to the changing nature of the project it was agreed that an Agile Metholodoly approach was to be followed.

The chosen Agile Metholodgy was Scrum. This was coupled with principles from Extreme Programming, such as: merciless refactoring and continuous integration. In a Scrum approach work is split into sprints, which define what should be done that week. These normally consist of user stories such as: *As a user I want to be able to search for a given module, so that I can find all notes for that module*. This story is used as a reminder for some feature value. The story is then split into tasks which act as acceptance criteria for the story - this acceptance criteria is used to evaluate the story once it's completed to make sure that it's fully completed.

Once the acceptance critera has been specified I estimate the complexity of that task, in comparision to a "goldilock" task. For my planning I adapted the planning poker technique - where the task goes from 1, 2, 3, 5, 8 and so on. Normally, if I got to the 15 mark then I felt the story was too large and needed to be reviewed and broke down, and the process would start again.

At the end of the sprint a review and restrospected was conducted, this was in the form of a blog post instead of a group, and the primary aims of this was to analyse performance and how I could improve over the next sprint. The retrospectives were key to highlighting issues as well as reflecting on what went well, so I can improve the process and the work produced.

Choosing story points per sprint was not just pot luck or what the customer, in this case the supervisor, wanted the most. At the end of every sprint a tally was kept of how many story points were completed, this would then be brought forward to the next sprint as how many story points should be completed that week. For example, if you completed 20 story points one week your next weeks estimation would be 20 story points worth.

- Taiga.io

In addition to Scrum the process has been modified to incorporate Extreme Programming principles. They involved test-driven-development, so the tests were written first to give me a better understanding of the underlying design. This coupled with the constant mericless refactoring allowed me to have confidence in the system I was building would still pass the appropriate tests. Furthermore, continuous integration tools were used on the project. TravisCI was used [CITE] and although it's normally for teams, it was good for the build automation and to ensure code was being plaed in the repository. Finally, CRC were used appropriately when thinking about how the classes interacted with one another - this was another way to help and think about the design of the application.

Chapter 2

Design

You should concentrate on the more important aspects of the design. It is essential that an overview is presented before going into detail. As well as describing the design adopted it must also explain what other designs were considered and why they were rejected.

The design should describe what you expected to do, and might also explain areas that you had to revise after some investigation.

Typically, for an object-oriented design, the discussion will focus on the choice of objects and classes and the allocation of methods to classes. The use made of reusable components should be described and their source referenced. Particularly important decisions concerning data structures usually affect the architecture of a system and so should be described here.

How much material you include on detailed design and implementation will depend very much on the nature of the project. It should not be padded out. Think about the significant aspects of your system. For example, describe the design of the user interface if it is a critical aspect of your system, or provide detail about methods and data structures that are not trivial. Do not spend time on long lists of trivial items and repetitive descriptions. If in doubt about what is appropriate, speak to your supervisor.

You should also identify any support tools that you used. You should discuss your choice of implementation tools - programming language, compilers, database management system, program development environment, etc.

Some example sub-sections may be as follows, but the specific sections are for you to define.

2.1   Overall Architecture

2.2   Some detailed design

2.2.1   Even more detail

2.3   User Interface

2.4   Other relevant sections

Chapter 3

Implementation

The implementation should look at any issues you encountered as you tried to implement your design. During the work, you might have found that elements of your design were unnecessary or overly complex; perhaps third party libraries were available that simplified some of the functions that you intended to implement. If things were easier in some areas, then how did you adapt your project to take account of your findings?

It is more likely that things were more complex than you first thought. In particular, were there any problems or difficulties that you found during implementation that you had to address? Did such problems simply delay you or were they more significant?

You can conclude this section by reviewing the end of the implementation stage against the planned requirements.

Chapter 4

Testing

Detailed descriptions of every test case are definitely not what is required here. What is important is to show that you adopted a sensible strategy that was, in principle, capable of testing the system adequately even if you did not have the time to test the system fully.

Have you tested your system on real users? For example, if your system is supposed to solve a problem for a business, then it would be appropriate to present your approach to involve the users in the testing process and to record the results that you obtained. Depending on the level of detail, it is likely that you would put any detailed results in an appendix.

The following sections indicate some areas you might include. Other sections may be more appropriate to your project.

4.1   Overall Approach to Testing

4.2   Automated Testing

4.2.1   Unit Tests

4.2.2   User Interface Testing

4.2.3   Stress Testing

4.2.4   Other types of testing

4.3   Integration Testing

4.4   User Testing

Chapter 5

Evaluation

Examiners expect to find in your dissertation a section addressing such questions as:

- Were the requirements correctly identified?

- Were the design decisions correct?

- Could a more suitable set of tools have been chosen?

- How well did the software meet the needs of those who were expecting to use it?

- How well were any other project aims achieved?

- If you were starting again, what would you do differently?

Such material is regarded as an important part of the dissertation; it should demonstrate that you are capable not only of carrying out a piece of work but also of thinking critically about how you did it and how you might have done it better. This is seen as an important part of an honours degree.

There will be good things and room for improvement with any project. As you write this section, identify and discuss the parts of the work that went well and also consider ways in which the work could be improved.

Review the discussion on the Evaluation section from the lectures. A recording is available on Blackboard.

Appendices

Appendix A

Third-Party Code and Libraries

If you have made use of any third party code or software libraries, i.e. any code that you have not designed and written yourself, then you must include this appendix.

As has been said in lectures, it is acceptable and likely that you will make use of third-party code and software libraries. The key requirement is that we understand what is your original work and what work is based on that of other people.

Therefore, you need to clearly state what you have used and where the original material can be found. Also, if you have made any changes to the original versions, you must explain what you have changed.

As an example, you might include a definition such as:

Apache POI library The project has been used to read and write Microsoft Excel files (XLS) as part of the interaction with the clients existing system for processing data. Version 3.10-FINAL was used. The library is open source and it is available from the Apache Software Foundation [2]. The library is released using the Apache License [1]. This library was used without modification.

Appendix B

Ethics Submission

This appendix includes a copy of the ethics submission for the project. After you have completed your Ethics submission, you will receive a PDF with a summary of the comments. That document should be embedded in this report, either as images, an embedded PDF or as copied text. The content should also include the Ethics Application Number that you receive.

Appendix C

Code Examples

3.1   Random Number Generator

The Bayes Durham Shuffle ensures that the psuedo random numbers used in the simulation are further shuffled, ensuring minimal correlation between subsequent random outputs [6].

```
#define IM1 2147483563
#define IM2 2147483399
#define AM (1.0/IM1)
#define IMM1 (IM1-1)
#define IA1 40014
#define IA2 40692
#define IQ1 53668
#define IQ2 52774
#define IR1 12211
#define IR2 3791
#define NTAB 32
#define NDIV (1+IMM1/NTAB)
#define EPS 1.2e-7
#define RNMX (1.0 - EPS)

double ran2(long *idum)
{
  /*--------------------------------------------------*/
  /* Minimum Standard Random Number Generator         */
  /* Taken from Numerical recipies in C               */
  /* Based on Park and Miller with Bays Durham Shuffle */
  /* Coupled Schrage methods for extra periodicity    */
  /* Always call with negative number to initialise   */
  /*--------------------------------------------------*/

  int j;
  long k;
  static long idum2=123456789;
```

```c
static long iy=0;
static long iv[NTAB];
double temp;

if (*idum <=0)
{
  if (-(*idum) < 1)
  {
    *idum = 1;
  }else
  {
    *idum = -(*idum);
  }
  idum2=(*idum);
  for (j=NTAB+7;j>=0;j--)
  {
    k = (*idum)/IQ1;
    *idum = IA1 *(*idum-k*IQ1) - IR1*k;
    if (*idum < 0)
    {
      *idum += IM1;
    }
    if (j < NTAB)
    {
      iv[j] = *idum;
    }
  }
  iy = iv[0];
}
k = (*idum)/IQ1;
*idum = IA1*(*idum-k*IQ1) - IR1*k;
if (*idum < 0)
{
  *idum += IM1;
}
k = (idum2)/IQ2;
idum2 = IA2*(idum2-k*IQ2) - IR2*k;
if (idum2 < 0)
{
  idum2 += IM2;
}
j = iy/NDIV;
iy=iv[j] - idum2;
iv[j] = *idum;
if (iy < 1)
{
  iy += IMM1;
}
```

```
  if ((temp=AM*iy) > RNMX)
  {
    return RNMX;
  }else
  {
    return temp;
  }
}
```

Annotated Bibliography

[1] Apache Software Foundation, "Apache License, Version 2.0," http://www.apache.org/licenses/LICENSE-2.0, 2004.

   This is my annotation. I should add in a description here.

[2] ——, "Apache POI - the Java API for Microsoft Documents," http://poi.apache.org, 2014.

   This is my annotation. I should add in a description here.

[3] H. M. Dee and D. C. Hogg, "Navigational strategies in behaviour modelling," *Artificial Intelligence*, vol. 173(2), pp. 329–342, 2009.

   This is my annotation. I should add in a description here.

[4] S. Duckworth, "A picture of a kitten at Hellifield Peel," http://www.geograph.org.uk/photo/640959, 2007, copyright Sylvia Duckworth and licensed for reuse under a Creative Commons Attribution-Share Alike 2.0 Generic Licence. Accessed August 2011.

   This is my annotation. I should add in a description here.

[5] M. Neal, J. Feyereisl, R. Rascunà, and X. Wang, "Don't touch me, I'm fine: Robot autonomy using an artificial innate immune system," in *Proceedings of the 5th International Conference on Artificial Immune Systems.* Springer, 2006, pp. 349–361.

   This paper...

[6] W. Press *et al.*, *Numerical recipes in C.* Cambridge University Press Cambridge, 1992, pp. 349–361.

   This is my annotation. I can add in comments that are in **bold** and *italics and then other content.*

[7] Various, "Fail blog," http://www.failblog.org/, Aug. 2011, accessed August 2011.

   This is my annotation. I should add in a description here.